단국대학교
카피킬러캠퍼스 표절 검사
결과 확인서

확 인
성 명
서 명

아이디	72070621	표절률	15%
소속	건축공학과건축구조		
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검사번호	00023710364	검사일자	2017.06.19 18:08
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검사명	표절검사		
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비고			

비교범위	[현재 첨부 문서] [카피킬러 DB]
검사설정	표절기준 [10 어절][5 문장], 인용/출처 표시문장 [제외], 법령/성경 포함문장 [제외], 목차/참고문헌 [제외]

검토 의견	

표절률 분석 정보

표절률	전체문장	동일문장	의심문장	인용/출처	법령/성경
15%	1,050	41	197	77	0

비교 문서 정보

번호	표절률	출처정보	비고
1	12%	[카피킬러 DB] Copykiller - 문서명 : 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures - 저자 : 박은천 - 발행 : 서울 : 단국대학교 대학원, 2007.2	
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5	1%	[카피킬러 DB] iiav.org - 문서명 : Unified Semiactive Control System Based on MR Damper for Cable ...	

검사 문서	비교 문서

표지

博士學位論文 비선형 감쇠장치가 설치된 건축구조물의 내진 및 내풍 성능평가를 위한 하이브리드 실험기법 및 가진시스템 설계 Hybrid Testing Method and Excitation Sys tem Design for Seismic and Wind-resistance Performance Evaluation of BuildingS tructures with Nonlinear Dampers 提 出 者 : 朴 恩 泉 指導敎授 : 閔 慶 元 2017 建築工學科 建築構造專攻 檀國大學校 大學院 비선형 감쇠장치가 설치된 건축구조물의 내진 및 내풍 성능평가를 위한 하이브리드 실험기법 및 가진시스템 설계 Hybrid Tes ting Method and Excitation System Design for Seismic and Wind-resistance Perfo rmance Evaluation of BuildingStructures with Nonlinear Dampers 이 論文을 博士學位論文으로 提出함 檀國大學校 大學院 建築工學科 建築構造專攻 朴 恩 泉

목차

문장표절률: **0%**

xiii ABSTRACT Hybrid Testing Method and Excitation System Design for Seismi c and Wind-resistance Performance Evaluation of BuildingStructures with Nonlin ear Dampers Park, Eunchurn Department of Architectural Engineering Graduate S chool Dankook University Advisor: Professor Min, Kyung-Won Abstract: This pa per proposes a hybrid testing method and the con- troller design of actuators to si mulate the responses of a buildingstruc- ture subjected to such dynamic excitation s as earthquakes and wind loads.

문장표절률: **0%**

Firstly, The hybrid testing method is a technique to experiment with a non- linear part in an entire structural system as an experimental model and a part that is exp ected to behave linearly as an analytical model.

문장표절률: **0%**

In this method, the interface between the experimental model and the analytical m odelshould be selected, and an experimental system should be constructed in whic h the interface of the analytical modelis designed to act as the ex- citation force o f the experimental model.

문장표절률: **0%**

In this paper, a substructure test as part of hybrid testing method by separating the structural system into the experimental structure and the analytical structure throu gh the shaking table, and the hybrid test of nonlinear vibration control devices, th e tuned liquid damper, the tuned liquid column damper and the tuned liquid mass damper as experimental models and buildingstructures as analytical models wered esigned and implemented to evaluate the performance.

문장표절률: **0%**

Furthermore, seismic performance evaluation of a building with magneto-rheolog ical (MR) damper installed by installing an MR damper, which is a 1-ton inter-s tory damper with high nonlinearity, on UTM, and the semi-active algorithm ap- plied to the MR damper were experimentally evaluated.

문장표절률: **0%**

This method can provide the possibility and quantitative basis for experimentally finding and applying the optimum algorithm of the control device with unspecific non- linearity or the performance of the device itself.

문장표절률: **0%**

Secondary, the controllersystem design that implements the dynamic response is a system that in- stalls a linear mass shaker or an active mass damper on a particul ar floor and implements a pseudo-seismic or pseudo wind load response in a full- scale building.

문장표절률: **0%**

In this paper, to simulate of wind-induced responses, a 76- story benchmark buil

ding which has an analytical model and wind load data were numerically analyzed, and to realize the seismic responses, the pseudo- earthquake excitation isimplemented by the hybrid mass damper with the real-scaled 5-story building.

문장표절률: **0%**

Also, an MR damper with the capacity of 1-ton was installed to evaluate the semi-active control performance of MR damper under earthquakes load in a real scale building.

문장표절률: **0%**

These techniques can be used to assess the seismic and wind resistance performance of real-scaled building xiv ABSTRACT structures and to evaluate the seismic and wind resistance performance of buildings with nonlinear control devices.

문장표절률: **0%**

Firstly, in Chapter 2, a hybrid testing method is proposed. First, a sub- structuring test of a buildingstructure using the hybrid testing method was performed by using a shaking table.

문장표절률: **0%**

Selecting a particular story of a shear-type buildingstructure as an interface, the upper part of the target structure is divided into the experimental substructure, and the lower part is divided into numerical analyticsubstructure.

문장표절률: **0%**

The boundary load at the interface separated by the substructure is calculated in real time of the abso- lute acceleration response of the experimental model.

문장표절률: **0%**

The acceleration of the interface between two substructures is calculated by time history analysis of the numerical substructure and used as command signal of the shaking table controller.

문장표절률: **0%**

At this time, the shaking table controller that generates the command signal minimizes the error between the generated command signal and the shaking tablemotion for the excitation of the experimental substructure.

문장표절률: **0%**

The validity and accuracy of the shaking tablesubstructure test of the hybrid testing method were confirmed by the experimental re- sults and the numerical analysis results.

문장표절률: **0%**

Secondly, a hybrid testing method for evaluating the control performance of a buildingstructure subjected to earthquake excitation of a tuned liquid type damper (TLD, TLCD, and TLMD), which is a nonlinear control device, was experimentally performed.

문장표절률: **0%**

This experiment is performed by using only control devices (TLD, TLCD, and TLMD), load cell and shaking table without physical buildingstructure because this experiment performs divided into nonlinear control device as an experimental model and building model as an analytical model.

문장표절률: **0%**

The struc- tural responses of the interactionsystem are calculated numerically in real time using an analytical structure model, a given earthquake record, and a shear force generated by the TLD, TLCD, and TLMD, and the shaking table reproduces both the controlled and uncontrolled absolute acceleration of the TLD, TLCD, and TLMD installed floor by manipulating the feedback gain of the shear forcesignal measured by the load cell positioned between the TLD/TLCD/TLMD and the shaking table.

문장표절률: **0%**

In this paper, the results of the hybrid test with those of the existing full-scalestructural test are com- pared, and it is present that accurate results of the seismic performance of buildings with nonlinear vibration control system can be obtained by using hybrid test without a physical model.

문장표절률: **0%**

In this paper, through not only TLD and TLCD which is verified through previous studies but also TLMD which is newly proposed to reduce bidirectional responses of buildingstructures is evaluated by using a hybrid testing method, a hybrid testing method is beneficial for that the recently proposed control device can be assessed experimentally in the designstage.

문장표절률: **0%**

In Chapter 3, firstly, a design of an actuator for simulating the wind- induced responses of a buildingstructure is presented.

문장표절률: **70%**

The actuator force is calculated by using the inverse transfer function of a targetstructural xv ABSTRACT responses to the actuator.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

The actuator force is calculated by using the inverse transfer function of a targetstructural response to the actuator.

문장표절률: **56%**

Filter and envelope function are used such that the error between wind and actuator induced responses is minimized by preventing the actuator from the exciting, unexpected modal responses and initial transient responses.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Filter and envelop function are used such that the error between wind and actuator induced responses is minimized by preventing the shaker from exciting unexpected modal responses and initial transient responses- The effectiveness of the proposed method is verified through a numerical example of a 76 story-bcnchmark building excited by wind load of which deterministic time history is given.

문장표절률: **92%**

The analyses result from a 76-story benchmark building problem in which wind load obtained by wind tunnel test is given, indicate that the actuator installed at a particular floor can approximately embody the structural responses induced by the wind load applied to each floor of the structure.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

The analyses results from a 76-story benchmark building problem in which wind load obtained by wind tunnel test is given, indicate that the actuator installed at a specific floor can approximately embody the structural responses induced by the wind load applied to each floor of the structure· The actuator designed by the proposed method can be effectively used for evaluating the wind response characteristics of a practical buildingstructure and for obtaining an accurate analytical model of the building under wind load.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

The analyses results from a 76-story benchmark building problem in which wind load obtained by wind tunnel test is given, indicate that the actuator installed at a specific floor can approximately embody the structural responses induced by the wind load applied to each floor of the structure.

문장표절률: **92%**

The actuator designed by the proposed method can be effectively used for evaluating the wind response characteristics of a buildingstructure in use and for obtaining an accurate analytical model of the build- ing under wind load.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

The analyses results from a 76-story benchmark build ing problem in which wind load obtained by wind tunnel test is given, indicate that the actuator installed at a specific floor can approximately embody the structural responses induced by the wind load applied to each floor of the structure· The actuator designed by the proposed method can be effectively used for evaluating the wind response characteristics of a practical buildingstructure and for obtaining an accurate analytical model of the build ing under wind load.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

The actuator designed by the proposed method can be effectively used for evaluating the wind response characteristics of a practical buildingstructure and for obtaining an accurate analytical model of the build ing under wind load.

문장표절률: **94%**

Secondly, a full scale forced vibration test simulating earthquake response isimplemented by using a hybrid mass damper.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

Finally, in the chapter 6, a full scale forced vibration test simulating earthquake response isimplemented by using a hybrid mass damper.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Finally, in the chapter 6, a full scale forced vibration test simulating earthquake r esponse isimplemented by using a hybrid mass damper.

문장표절률: **56%**

The finite element model of the real-scaled buildingstructure was analytically con structed, and the model was updated using the results experimentally measured by the forced vibration test.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

The finite element(FE) model of the structure was analytically constructed using A NSYS and the model was updated using the results experimentally measured by th e forced vibration test.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

The finite element(FE) model of the structure was analytically constructed using A NSYS and the model was updated using the results experimentally measured by th e forced vibration test.

문장표절률: **45%**

Pseudo-earthquake excitation tests showed that the hybrid mass damper induced f loor responses coincided with the earthquake induced ones which were numericall y calculated based on the updated FE model.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

Pseudo-earthqiiake excitation tests showed that HMD hybrid mass damper induce d floor responses coincided with the earthquake induced ones which was numerica lly calculated based on the updated FE model.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Pseudo-earthquake excitation tests showed that HMD hybrid mass damper induce d floor responses coincided with the earthquake induced ones which was numerica lly calculated based on the updated FE model.

문장표절률: **0%**

Real-scaled MR damper was installed to verify the effectiveness of the pseudo-ea rthquake experiment in a real scale building.

문장표절률: **0%**

The MR damper-based control systems are realized when an MR damper is desig ned by deriving a suboptimal design procedure considering optimiza- tion proble m and magnetic analysis, and then a damper with the capacity of 1.0 ton is manu factured.

문장표절률: **0%**

In the experiments, a linear active mass driver and the linear shaker seismic simul ation testing method are used to excite the buildingstructure to match the full-scal e building vibrate as if the build- ing undergoes an earthquake.

문장표절률: **0%**

Under the four historical earthquakes and one filtered artificial earthquake, the pe rformance of the semi-active control algo- rithms including the passive optimal c ase is experimentally evaluated.

문장표절률: **0%**

From the experimental results, one can conclude that the Lyapunov and semi- act ive neuro-control algorithms are appropriate in reducing accelerations of the stru ctural system, and the passive optimal case and the maximum en- ergy dissipatio n algorithm show the excellent performance in reducing the first-floor displaceme nt.

문장표절률: **0%**

In Chapter 4, The MR damper with the capacity of 1-ton was used from chapter 3, a hybrid testing method of the real-scaled building with semi- active controllin g MR damper implemented in the chapter 2 was applied by hybrid testing method technique.

문장표절률: **0%**

This study presents the quantitative evaluation of the seismic performance of a bui ldingstructure installed with an MR damper using a hybrid testing method as desc ribed in chapter 2.

문장표절률: **0%**

A building modelis identified from the forced vibration testing results of a full-sca le five-story building in Chapter 3 and is used as the numerical sub- structure, and an MR damper as an experimental substructure is physically tested using a universal testing machine (UTM).

문장표절률: **60%**

First, the force required to drive the displacement of the story, at which the MR damper is located, xvi ABSTRACT is measured from the load cell attached to the UTM.

[Copykiller] Real-time Hybrid Test on a Semi-actively Controlled Building Structure Equipped with Full-scale MR Dampers

저자 : Park, E[Park, Eunchurn];Min, KW[Min, Kyung-Won];Lee, SK[Lee, Sung-Kyung];Lee, SH[Lee, Sang-Hyun];Lee, HJ[Lee, Heon-Jae];Moon, SJ[Moon, Seok-Jun];Jung, HJ[Jung, Hyung-Jo]
발행 : Dec-2010

First, the force required to drive the displacement of the story, at which the MR damper is located, is measured from the load cell attached to the UTM.

문장표절률: **100%**

The measured force is then returned to a control computer to calculate the response of the numerical substructure. Finally, the experimental substructure is excited by the UTM with the calculated response of the numerical substructure.

[Copykiller] Real-time Hybrid Test on a Semi-actively Controlled Building Structure Equipped with Full-scale MR Dampers

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발행 : Dec-2010

The measured force is then returned to a control computer to calculate the response of the numerical substructure. Finally, the experimental substructure is excited by the UTM with the calculated response of the numerical substructure.

문장표절률: **77%**

The hybrid testing method implemented in this study is validated because the hybrid testing results obtained by application of sinusoidal and earth- quake excitations and the corresponding analytical results obtained using the Bouc-Wen model as the control force of the MR damper with respect to input currents are in good agreement.

[Copykiller] Real-time Hybrid Test on a Semi-actively Controlled Building Structure Equipped with Full-scale MR Dampers

저자 : Park, E[Park, Eunchurn];Min, KW[Min, Kyung-Won];Lee, SK[Lee, Sung-Kyung];Lee, SH[Lee, Sang-Hyun];Lee, HJ[Lee, Heon-Jae];Moon, SJ[Moon, Seok-Jun];Jung, HJ[Jung, Hyung-Jo]
발행 : Dec-2010

The RT-HYTEM implemented in this study is validated because thereal-time hybrid testing results obtained by application of sinusoidal and earth quake excitations and the corresponding analytical results obtained using the Bouc-Wen model as the control force of the MR damper with respect to input currents are in good agreement.

문장표절률: **81%**

Also, the results from the hybrid testing method for the passive -on and -off controlshow that the structural responses did not decrease further by the excessive control force, but de- creased due to the increase of the current applied to the MR damper.

[Copykiller] Real-time Hybrid Test on a Semi-actively Controlled Building Structure Equipped with Full-scale MR Dampers

저자 : Park, E[Park, Eunchurn];Min, KW[Min, Kyung-Won];Lee, SK[Lee, Sung-Kyung];Lee, SH[Lee, Sang-Hyun];Lee, HJ[Lee, Heon-Jae];Moon, SJ[Moon, Seok-Jun];Jung, HJ[Jung, Hyung-Jo]
발행 : Dec-2010

Also, the results from RT-HYTEM for the passive -on and -off controlshow that the structural responses did not decrease further by the excessive control force, but de creased due to the increase of the current applied to the MR damper.

문장표절률: **78%**

Also, two semi-active control algorithms (modulated homogeneous friction and the clipped-optimal control algorithms) are applied to the MR damper to optimally control the structural responses.

[Copykiller] Real-time Hybrid Test on a Semi-actively Controlled Building Structure Equipped with Full-scale MR Dampers

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발행 : Dec-2010

Also, two semi-active control algorithms (modulated homogeneous friction and the clipped-optimal control algorithms) are applied to the MR damper in order to optimally control the structural responses.

문장표절률: **68%**

To compare the hybrid testing method and numerical results, Bouc-Wen model parameters are identified for each input current.

[Copykiller] Real-time Hybrid Test on a Semi-actively Controlled Building Structure Equipped with Full-scale MR Dampers

저자 : Park, E[Park, Eunchurn];Min, KW[Min, Kyung-Won];Lee, SK[Lee, Sung-Kyung];Lee, SH[Lee, Sang-Hyun];Lee, HJ[Lee, Heon-Jae];Moon, SJ[Moon, Seok-Jun];Jung, HJ[Jung, Hyung-Jo]
발행 : Dec-2010

To compare the RT-HYTEM and numerical results, Bouc-Wen model parameters are identified for each input current. The results of the comparison of experimental and numerical responses show that it is more practical to use RT-HYTEM in semi-active devices such as MR dampers.

문장표절률: **60%**

The results of the comparison of experimental and numerical responses show that it is more practical to use the hybrid testing method in semi-active devices such as MR dampers.

[Copykiller] Real-time Hybrid Test on a Semi-actively Controlled Building Structure Equipped with Full-scale MR Dampers

저자 : Park, E[Park, Eunchurn];Min, KW[Min, Kyung-Won];Lee, SK[Lee, Sung-Kyung];Lee, SH[Lee, Sang-Hyun];Lee, HJ[Lee, Heon-Jae];Moon, SJ[Moon, Seok-Jun];Jung, HJ[Jung, Hyung-Jo]
발행 : Dec-2010

To compare the RT-HYTEM and numerical results, Bouc-Wen model parameters are identified for each input current. The results of the comparison of experimental and numerical responses show that it is more practical to use RT-HYTEM in semi-active devices such as MR dampers.

문장표절률: **62%**

The test results indicate that a control algorithm can be experimentally applied to

[Copykiller] Real-time Hybrid Test on a Semi-actively Controlled Building Structure Equipped with Full-scale MR Dampers the MR damper using the hybrid testing method.

저자 : Park, E[Park, Eunchurn];Min, KW[Min, Kyung-Won];Lee, SK[Lee, Sung-Kyung];Lee, SH[Lee, Sang-Hyun];Lee, HJ[Lee, Heon-Jae];Moon, SJ[Moon, Seok-Jun];Jung, HJ[Jung, Hyung-Jo]
발행 : Dec-2010

The test results show that a control algorithm can be experimentally applied to the MR damper using RT-HYTEM. This article provides a discussion on each algorithm with respect to the seismic performances.

문장표절률: **0%**

This study also provides a discussion on each algorithm concerning the seismic performances. Keywords: hybrid testing method, substructuring technique, tuned liquid type damper, control-structure interaction, inverse transfer function, active tuned mass damper, hybrid mass damper, design of an actuator, 76-story benchmark problem building, force vibration testing, real-scale building, system identification, finite element model updating, magneto-rheological damper, semi-active control algorithms.

출처표시 문장 문장표절률: **0%**

Student Number : 72070621 xvii Chapter 1 Introduction 1.1 General Accurate identification of the dynamic response characteristics of buildingstructures excited by external loads such as earthquakes and wind loads is essential not only for the safety and service ability evaluation of buildingstructures but for the validation of analytical models used for seismic or wind design(Ljung, 1987).

출처표시 문장 문장표절률: **0%**

In the System Identification (SI) field, which constructs a system matrix that describes precise input and output relationships to build an analytical model of an architectural structure, it is critical that inputshould have sufficient energy to excite fundamentalstructural modes and a high quality of output containing structural information should be measured(Alvin and Park, 1994; Madenci and Barut, 1994).

문장표절률: **0%**

However, full- scale dynamic testing is difficult due to size and weight limitations in most large civil engineering structures.

문장표절률: **0%**

Also, in most cases, it is very difficult or impossible to extrapolate the results of small-scale model tests as a result of a full-scalestructure that operates non-linearly in most cases.

문장표절률: **0%**

Therefore, it is used as a means to evaluate the dynamic performance of a building or to implement the system identification process by installing an excitation systemsuch as an eccentric exciter or a linear mass shaker which excite the fundamental modes, in the building.

문장표절률: **0%**

However, to evaluate the seismic and the wind resistance performance accurately, it is necessary to fully reflect the characteristics of the seismic load and the wind load.

문장표절률: **0%**

One method to overcome these limitations is to use the hybrid testing method. This technique for the dynamic testing of large-scalestructures, typically involving nonlinearities, does not test the entire structure as a whole.

문장표절률: **0%**

Instead, it often happens that nonlinearity or unpredictable behavior is concentrated in a limited number of local parts of the overall structure.

문장표절률: **0%**

Those important local parts are experimentally tested, while therest of the structure, which is assumed to behave linearly, in essence, is modeled numerically.

문장표절률: **0%**

Numerical and experimental parts are allowed to interact with each other to produce the response of the entire system. The advantage of the hybrid testing technique over the reduced-scale model testing is that the experimental substructure is tested at full size and the scaling effect can be eliminated.

문장표절률: **0%**

Another method to overcome above limitations is to design controller of actuators to simulate earthquake and wind-induced responses.

문장표절률: **0%**

This is a 1 Chapter. 1. Introduction forced vibration testing method to implement seismic or wind responses of a buildingstructure by using a vibration control devic e already installed in a real buildingsuch as ATMD or installing additional excite r in specific story of the building.

문장표절률: **0%**

For the successful application of this method, several issues should be considered. First, interaction effects between the actuators and buildingstructure and dynamic characteristics of the actuator itself should be compensated.

문장표절률: **0%**

Second, because this method uses inverse transfer function method, unexpected mo dal responses and transient responses should be re- duced.

문장표절률: **0%**

This method may evaluate the seismic and wind performance not only of the exist ing building but for of the real scale building equipped with the nonlinear vibratio n control device.

문장표절률: **0%**

1.2 Objectives and Contents Figure 1.2 shows the contents of chapters and their re lations in this paper. It can be classified into a hybrid testing method and a pseudo -excitation system for simulating a dynamic load of buildingstructures.

문장표절률: **0%**

Verification methods can be summarized as numerical analysis, shaking table exp eriment, UTM experiment, and experiment with full-size building with HMD.

문장표절률: **0%**

The objective of this study is to design a hybrid testing method and a controller of an exciter to perform an experimental evaluation of seismic and wind resistance p erformance of buildingstructures equipped with nonlinear vibration control device s.

문장표절률: **0%**

The contents for these objectives are as follows; First, in chapter 2, the hybrid testi ng method is proposed. To be imple- mented by the hybrid testing technique and accurately represent the whole buildingstructure, the experimental and numerical substructures must oper- ate in parallel with minimal errors at the interface betwe en them.

문장표절률: **0%**

Three fac- tors are essential in the implementation issues of the hybrid testing met hod. Those issues are the measurement of the interface force between two sub- str uctures, the calculation of the numerical substructure, and the loading operation o f the experimental substructure with an actuator.

문장표절률: **0%**

The responses of the shared degrees-of-freedom (DOF) are calculated using the n umeri- cal model and passed to the controller of actuators or a shaking table.

문장표절률: **0%**

The controller generates signals driving the actuators in order to impose these resp onses on the experimental substructure.

문장표절률: **0%**

To be replicated by the behav- ior of the whole structure by the hybrid testing me thod, it is important to design the controller of the actuators or the shaking table, so that differ- ence between the expected and actual measured behavior at the inte rface of the two substructures is minimized.

문장표절률: **0%**

The vibration control effect of a tuned liquid type damper (TLD/TLCD) for a buil dingstructure excited by earth- quake load is experimentally evaluated through th e hybrid testing method.

문장표절률: **0%**

The hybrid testing method doesn't require a physical buildingstructural model in p erforming the experiment of a TLD/TLCD-structure interaction 2 Chapter.

출처표시 문장 문장표절률: **0%**

1. Introduction system and it only uses a TLD/TLCD which is known to have stro ng non- linearity dependent on response amplitude, excitation frequency, and dep th to length ratio (Yalla, 2001).

문장표절률: **0%**

A new control device, which is called tuned liquid mass damper (TLMD), is discussed in this chapter. The functional characteristic of a TLMD used in this study is that its mass is composed of both a mass of TLCD tank itself and that of liquid within a tank.

문장표절률: **0%**

Natural rubbers were also used to substitute the stiffness of a TMD. Therefore, a TLMD employed in this study operates as a TLCD in one direction and behaves as a TMD in the other orthogonal direction.

문장표절률: **0%**

Regarding the field of structural testing, hybrid testing method also implemented in this study. As mentioned in the previous sentence, TLD and TLCD has been subjected to many researches and experiments and has been verified by the hybrid testing method in this study.

문장표절률: **0%**

Therefore, as hybrid testing method of build- ing controlled by TLMD, it is significant to use the hybrid testing method technique by validating the control performance of the newly proposed con- trol device by comparison between the SDOF-actuator experiment method and the hybrid testing method method.

문장표절률: **95%**

The structural responses of the in- teractionsystem are calculated numerically in real-time using the analytical structural model with the excitations of measured control force, user-defined base earthquake loads, and its statespace realization incorporated in the in- tegrated controller of an actuator.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

The structural responses of the in teractionsystem are calculated numerically in real time using the analytical structural model with the excitations of measured control force, user-defined base earthquake loads, and its statespace realization incorporated in the in tegrated controller of the shaking table.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

The structural responses of the in teractionsystem are calculated numerically in real time using the analytical structural model with the excitations of measured control force, user-defined base earthquake loads, and its statespace realization incorporated in the in tegrated controller of the shaking table.

문장표절률: **33%**

Also, in order to minimize the distortion of the acceleration of the shaking table or an actuator's displacement, the inverse transfer function of the shaking table or the actuator is identified and its statespace realization isimplemented in the hybrid testing method controller.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

Also, in order to minimize the distortion of the acceleration of the shaking table, the inverse transfer function of the shaking table is identified and its statespace realization isimplemented in the shaking table controller.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Also, in order to minimize the distortion of the acceleration of the shaking table, the inverse transfer function of the shaking table is identified and its statespace realization isimplemented in the shaking table controller.

문장표절률: **64%**

Secondly, in chapter 3, simulation of dynamic responses of a buildingstructure using a linear mass shaker is conducted. In order for the linear shaker to keep the structure in the target response trajectory, an inverse transfer function of a structural response to the shaker force is obtained us- ing a statespace form governing equation of the structure and the discrete Fourier transform of structural response is performed.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

1. In order for the linear actuator to keep the structure in the target response trajectory, an inverse transfer function of a structural response to the shaker force is obtained us ing a statespace form governing equation of the structure and the discrete Fourier transform of structural response is performed.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

In order for the linear actuator to keep the structure in the target response trajectory, an inverse transfer function of a structural response to the shaker force is obtained us ing a statespace form governing equation of the structure and the discrete Fourier transform of structural response is performed.

문장표절률: **61%**

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시

Filter and envelope function are used such that the error between wind and actuator or induced responses is minimized by preventing the shaker from the exciting unex－ pected modal response and initial transient response.

스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

Filter and envelop function are used such that the error between wind and actuator induced responses is minimized by preventing the shaker from exciting ime^ected modal response and initial transient response.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real－time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Filter and envelop function are used such that the error between wind and actuator induced responses is minimized by preventing the shaker from exciting unex pected modal response and initial transient response.

문장표절률: **100%**

The effectiveness of the proposed method is verified through a numerical example of a 76 story－ benchmark building excited by wind load of which deterministic time history is given.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

The effectiveness of the proposed method is verified through a numerical example of a 76 story－ benchmark building excited by wind load of which deterministic time history is given.

문장표절률: **0%**

The effect of the type of the targetstructural response on a con－ vergence of the shaker forcesignal and the error magnitude is investigated.

문장표절률: **0%**

Moreover, in this chapter, forced vibration pseudo－earthquake tests using an HMD(hybrid mass damper) installed on the 4th floor of the real－scale five－ story modal testing tower were performed.

문장표절률: **0%**

To experimentally evaluate the seismic performance of a buildingstructure with accuracy, shaking tabletest should be conducted.

문장표절률: **0%**

However, it is practically impossible and very expen－ sive to excite a real scalestructure using the shaking table. Yu presented a 3 Chapter.

출처표시 문장 　 문장표절률: **0%**

1. Introduction linear shaker system to simulatestructural seismic response by using inverse transfer function of the structural response induced by the linear shaker (Yu et al., 2005) is of the structure excited by earthquake load.

문장표절률: **0%**

Real－scaled MR damper was installed to verify the effectiveness of the pseudo－earthquake ex－ periment in a real scale building.

문장표절률: **0%**

Under the four historical earthquakes and one filtered artificial earthquake, the performance of the semi－active control algorithms including the passive optimal case is experimentally evaluated by the pseudo－earthquake test method.

문장표절률: **0%**

Finally, in chapter 4 shows the experimental verification of hybrid test－ ing method applied to UTM with an MR damper. The MR damper with the capacity of 1－ton was used from chapter 3, hybrid testing method of the real－scaled building with semi－active controlling MR damper implemented in the chapter 2 was applied by hybrid testing method technique.

문장표절률: **67%**

This study presents the quantitative evaluation of the seismic performance of a build－ ing structure installed with a MR damper using hybrid testing method.

[Copykiller] Real－time Hybrid Test on a Semi－actively Controlled Building Structure Equipped with Full－scale MR Dampers

저자 : Park, E[Park, Eunchurn];Min, KW[Min, Kyung－Won];Lee, SK[Lee, Sung－Kyung];Lee, SH[Lee, Sang－Hyun];Lee, HJ[Lee, Heon－Jae];Moon, SJ[Moon, Seok－Jun];Jung, HJ[Jung, Hyung－Jo]

	발행 : Dec-2010
	This article presents the quantitative evaluation of the seismic performance of a build ing structure installed with a magnetorheological MR damper using RT-HYTEM.
문장표절률: **83%**	[Copykiller] Real-time Hybrid Test on a Semi-actively Controlled Building Structure Equipped with Full-scale MR Dampers 저자 : Park, E[Park, Eunchurn];Min, KW[Min, Kyung-Won];Lee, SK[Lee, Sung-Kyung];Lee, SH[Lee, Sang-Hyun];Lee, HJ[Lee, Heon-Jae];Moon, SJ[Moon, Seok-Jun];Jung, HJ[Jung, Hyung-Jo] 발행 : Dec-2010
A building modelis identified from the forced vibration testing results of a full-scale five-story building and is used as the numerical substructure, and an MR damper corresponding to an experimental substructure is physically tested using a universal testing machine (UTM).	A building modelis identified from the force-vibration testing results of a full-scale five-story building and is used as the numerical substructure, and an MR damper corresponding to an experimental substructure is physically tested using a universal testing machine (UTM).
문장표절률: **100%**	[Copykiller] Real-time Hybrid Test on a Semi-actively Controlled Building Structure Equipped with Full-scale MR Dampers 저자 : Park, E[Park, Eunchurn];Min, KW[Min, Kyung-Won];Lee, SK[Lee, Sung-Kyung];Lee, SH[Lee, Sang-Hyun];Lee, HJ[Lee, Heon-Jae];Moon, SJ[Moon, Seok-Jun];Jung, HJ[Jung, Hyung-Jo] 발행 : Dec-2010
First, the force required to drive the displacement of the story, at which the MR damper is located, is measured from the load cell attached to the UTM.	First, the force required to drive the displacement of the story, at which the MR damper is located, is measured from the load cell attached to the UTM.
문장표절률: **100%**	[Copykiller] Real-time Hybrid Test on a Semi-actively Controlled Building Structure Equipped with Full-scale MR Dampers 저자 : Park, E[Park, Eunchurn];Min, KW[Min, Kyung-Won];Lee, SK[Lee, Sung-Kyung];Lee, SH[Lee, Sang-Hyun];Lee, HJ[Lee, Heon-Jae];Moon, SJ[Moon, Seok-Jun];Jung, HJ[Jung, Hyung-Jo] 발행 : Dec-2010
The measured force is then returned to a control computer to calculate the response of the numer- ical substructure. Finally, the experimental substructure is excited by the UTM with the calculated response of the numerical substructure.	The measured force is then returned to a control computer to calculate the response of the numer ical substructure. Finally, the experimental substructure is excited by the UTM with the calculated response of the numerical substructure.
문장표절률: **63%**	[Copykiller] Real-time Hybrid Test on a Semi-actively Controlled Building Structure Equipped with Full-scale MR Dampers 저자 : Park, E[Park, Eunchurn];Min, KW[Min, Kyung-Won];Lee, SK[Lee, Sung-Kyung];Lee, SH[Lee, Sang-Hyun];Lee, HJ[Lee, Heon-Jae];Moon, SJ[Moon, Seok-Jun];Jung, HJ[Jung, Hyung-Jo] 발행 : Dec-2010
The hybrid testing method implemented in this study is validated because the hybrid testing results obtained by application of sinusoidal and earthquake excita- tions and the corresponding analytical results obtained using the Bouc-Wen model as the control force of the MR damper withinput currents are in good agreement.	The RT-HYTEM implemented in this study is validated because thereal-time hybrid testing results obtained by application of sinusoidal and earthquake excita tions and the corresponding analytical results obtained using the Bouc-Wen model as the control force of the MR damper with respect to input currents are in good agreement.
문장표절률: **83%**	[Copykiller] Real-time Hybrid Test on a Semi-actively Controlled Building Structure Equipped with Full-scale MR Dampers 저자 : Park, E[Park, Eunchurn];Min, KW[Min, Kyung-Won];Lee, SK[Lee, Sung-Kyung];Lee, SH[Lee, Sang-Hyun];Lee, HJ[Lee, Heon-Jae];Moon, SJ[Moon, Seok-Jun];Jung, HJ[Jung, Hyung-Jo] 발행 : Dec-2010
Also, the results from hybrid testing method for the pas- sive -on and -off control show that the structural responses did not decrease further by the excessive control force, but decreased due to the increase of the current applied to the MR damper.	Also, the results from RT-HYTEM for the pas sive -on and -off controlshow that the structural responses did not decrease further by the excessive control force, but decreased due to the increase of the current applied to the MR damper.
문장표절률: **100%**	[Copykiller] Real-time Hybrid Test on a Semi-actively Controlled Building Structure Equipped with Full-scale MR Dampers 저자 : Park, E[Park, Eunchurn];Min, KW[Min, Kyung-Won];Lee, SK[Lee, Sung-Kyung];Lee, SH[Lee, Sang-Hyun];Lee, HJ[Lee, Heon-Jae];Moon, SJ[Moon, Seok-Jun];Jung, HJ[Jung, Hyung-Jo] 발행 : Dec-2010
Also, two semi-active control al- gorithms (modulated homogeneous friction and the clipped-optimal control algorithms) are applied to the MR damper in order to optimally control the structural responses.	Also, two semi-active control al gorithms (modulated homogeneous friction and the clipped-optimal control algorithms) are applied to the MR damper in order to optimally control the structural responses.
문장표절률: **0%**	
To be compared with the hybrid testing method and numerical results, the Bouc-Wen model parameters should be identi- fied for each input current.	
문장표절률: **0%**	
The results of the comparison of experimental and numerical responses show that it is more practical to use hybrid testing method in semi-active devices such as MR dampers.	
문장표절률: **0%**	
The test results indicate that a control algorithm can be experimentally applied to	

the MR damper using hybrid testing method.

인용포함 문장 문장표절률: **0%**

This study also provides a discussion on each algorithm with respect to the seismic performances. 4 Chapter. 1. Introduction 4VCKFDU 5FTU .FUIPE G 3FBM 5JNF)ZCSJE 5FTU .FUIPE 4VCTUSVDUVSJOH 5FDIOJRVF /VNFSJDBM "OBMZTJT 3X5JU I) :35F&B.M T 5DFBTMFU EGP #S V/JPMEOJ OMJHO 4FUBSSV %DUFVWSJFDF 15VFOSGFPESN -JBROVDJFE &%WBBNMVQBFUSJPO PG 1PGT F.V3E %P B&NBSQUIFSR GVPBSL 3FF &BYM QTFDSBJMNFEF O#UVJMEJOH 15VFOSGFPESN -JBROVDJFE &$WPBMVMVNBUOJP %OB PNGQFS 4IBLJOH 5BCMF 5FTU 34F5 N)J: "5D&U.JW FP G$ 3PFOBUMS P4MD "BMMHFPES .JUI3N %TBNQFS XJUI 15VFOSGFPESN -JBROVDJFE &.WBBTMVT B%UBJPNOQ PFGS %GPFST 4JHJNO VPMGB &UYJODHJU B%UZJPOOB N4ZJDTU -FPNB ET 4JNVMBUJOH 8JOE 3FTQPOTF 4JNVMBUJOH 4FJTNJD 3FTQPOTF "DUVBUPS 3FBM 4DBMF 'JWF 4USPZ #VJMEJOH Figure 1.1: Contents of chapters and theier relations 1.3 Literature Review 1.3.1 Hybrid testing method Since the substructuring technique is first developed for large-scalestruc- tures by Nakashima et al.

문장표절률: **0%**

(1992), several pieces of research have been per- formed on the substructuring technique both experimentally and analyti- cally to overcome difficulties in the test of large-scalestructures.

출처표시 문장 문장표절률: **0%**

Blakebor- ough et al. (2001); Darby et al. (2001) focused on the control algorithm for operating hydraulic actuators and conducted experiments for a one-story frame with horizontal and rotational DOF and its corresponding numerical substructure, which shows the linear or nonlinear behavior (Darby et al., 2002).

출처표시 문장 문장표절률: **0%**

Neild et al. (2005) separated a largestructural mass of the single DOF system into two parts and selected the smaller one as the experimen- tal substructure and the larger one with attached spring and dashpot as the numerical substructure to conduct a shaking tabletest(Neild et al., 2005).

출처표시 문장 문장표절률: **0%**

Nakashima and Pan applied the method to a base-isolated structure consist- ing of the base-isolation layer as an experimental substructure and the rest of the upper structural model as a numerical substructure(Nakashima and Masaoka, 1999).

출처표시 문장 문장표절률: **0%**

Besides, they developed a mixed control algorithm using both displacement and force for its implementation(Pan et al., 2005).

출처표시 문장 문장표절률: **0%**

5 Chapter. 1. Introduction Takanashi et al. (1975, 1980) have firstly developed the pseudo-dynamic testing method, in which only a part of the whole structure, mainly being expected to show nonlinearity, is manufactured and tested while the remain- der showing linearity is numerically calculated(Takanashi et al., 1975, 1980).

출처표시 문장 문장표절률: **0%**

Because there exists propagation of experimental errors in pseudo-dynamic testing methods, thestability, and accuracy of the numerical integration methods were investigated(Shing and Mahin, 1983, 1984).

문장표절률: **0%**

In these pseudo- dynamic testing methods, as implied in thename, the experimental part is not "dynamically" but "statically" excited under the loading condition which makes the testing part represent identical displacement response to that of the part in whole structure excited by considered dynamic load such as ground acceleration.

출처표시 문장 문장표절률: **0%**

Horiuchi et al. (1999) compensated the time-delay effect caused mainly by analytical procedure in the real-time hybrid testing method(Horiuchi et al., 1999).

문장표절률: **0%**

For its experimental verification, a small portion of mass was separated from a mass-spring-dashpot system, and only the small part of the mass was tested considering the effects of the other parts analytically.

문장표절률: **0%**

Iemura et al. (1999); Igarashi et al. (2000) verified the effect of vibration control devices such as a tuned mass damper and an active mass damper installed in a structure excited by ground acceleration, using the hybrid testing method in which th e control devices were experimental parts and the remaining structural model was a numerical part.

문장표절률: **0%**

The acceleration signal of the moving mass of the devices was measured and used as input to the numerical modellemura et al.

출처표시 문장 문장표절률: **0%**

(1999); Igarashi et al. (2000). TLD dissipates structural vibratory energy by tuning the frequency of the liquidsloshing to one of the structure(Soong and Dargush, 1997).

출처표시 문장 문장표절률: **0%**

TLD has been applied to the control of wind-induced acceleration response(Chang and Qu, 1998), and recently, some investigations on the seismic control performance of the TLD have been made(Banerji et al., 2000).

출처표시 문장 문장표절률: **0%**

In order to describe the behavior of the TLD, linear model based on tuned mass damper analogy(Sun et al., 1995) and linear wave theory, nonlinear stiffness and damping model(Yu et al., 1999), and sloshing-slamming analogy(Yalla, 2001) can be used.

문장표절률: **0%**

However, because anymodel has the error in capturing the real dynamic characteristics of the control force generated by the TLD and furthermore the error increases for the case of non-stationary excitation such as the earthquake, evaluation of the seismic control performance of the TLD only numerically has the accuracy problem.

출처표시 문장 문장표절률: **0%**

Recently, the TLCD has received the attention of researchers as a type of auxiliary mass system(Samali et al., 1998).

문장표절률: **0%**

TLCD has the control charac- teristics similar to that of tuned mass damper (TMD), which is one of most frequently used dampers for vibration control.

문장표절률: **0%**

Since the viscosity term in the governing equation of motion of TLCD is a function of the absolute value of liquid velocity, the equation is non-linear, and the dynamic characteristics of TLCD depend on the magnitude and the characteristics of excitation forces 6 Chapter.

출처표시 문장 문장표절률: **0%**

1. Introduction and the corresponding structural responses of the floor at which TLCD is installed(Yalla, 2001). Two or more TMDs and TLCDs have been installed in a building to control bidirectional responses(Xu and Igusa, 1992; Fujino and Sun, 1993; Yamaguchi and Harnpornchai, 1993; Igusa and Xu, 1994; Jangid and Datta, 1997; Li, 2000; LI et al., 2000; Singh et al., 2002) .

문장표절률: **0%**

Since multi-tuned mass dampers (MTLDs) had been proposed by Xu and Igusa (1992); Igusa and Xu (1994), many researchers have devoted their efforts to improve the control performance of MTLDs(Fujino and Sun, 1993; Yamaguchi and Harnporn- chai, 1993; Jangid and Datta, 1997; Li, 2000; LI et al., 2000; Singh et al., 2002; ZHANG and ZHONG, 2004).

문장표절률: **0%**

Especially, Jangid and Datta (1997); Singh et al. (2002) have studied the MTMDs by which the torsional response of buildingstructures subjected to bidirectional vibrations can be reduced.

문장표절률: **0%**

They also proposed the optimum parameters such as mass, frequency and damping ratios, in addition to the installation locations of MTMDs, to con- trol the torsional response.

문장표절률: **0%**

Fujino and Sun (1993) have studied about the optimal frequency ratio and the optimal number of MTLDs. However, for applying these multi dampers to buildingstructures, there have been short- comings such as high installation cost, hard maintenance and additional retrofitting of the story at which they are installed.

문장표절률: **0%**

Additionally, applying the pendulum type TMD used in Taipei 101 building has a limitation that the structural plan should be the similar shape in both weak and str ong axes.

출처표시 문장 문장표절률: **0%**

Also, this type of TMD needs a large installationspace(Haskett et al., 2004). 1.3.2 Design of Excitation System for Simulating Dynamic Loads In the field of earthqu ake engineering, forced vibration tests for evaluating the dynamic characteristics of structures and evaluating seismic performance have been widely carried out fro m shaking table, eccentric exciter, and re- action wall to shrinking andreal scales tructures.

출처표시 문장 문장표절률: **0%**

Several studies on the system identification to establish the analytical structural m odel by using the modal characteristics, which are obtained by forced vibration te sts, have also been carried out(Halling et al., 2001; Min et al., 2004).

문장표절률: **0%**

The primary purpose of system identification is to construct an analytical model t hat can simulate the relationship between the excitation load and the measuremen t response obtained in the forced excitation experiment.

출처표시 문장 문장표절률: **0%**

Juang (1994) proposed the system identification method in the frequency domain by using matrix decomposition and that in the time domain by em- ploying Mark ov parameters and Observer/Kalman filter(Juang, 1994).

문장표절률: **0%**

Dyke et al. (1994) obtained the system matrix of a structure by applying model re duction technique after exciting a 3-story small scale structural model with the sh aking table and the active mass driver, and then performing the sys- 7 Chapter.

출처표시 문장 문장표절률: **0%**

1. Introduction tem identification for the respective excitation loads. However, the analytical model that is identified by adopting their methods only describes its inp ut and output relations and does not represent physical information such as the ma ss, viscosity, and stiffness(Dyke et al., 1994).

출처표시 문장 문장표절률: **0%**

Alvin and Park (1994) extracted the finite element model that has its physical mea ning by us- ing common based-normalized system identification (CBSI) techniqu e(Alvin and Park, 1994).

문장표절률: **0%**

The shaking tabletest, in which the loads similar to real earthquakes can be easily simulated, is frequently taken to experimentally assess the seismic performance of a structure with high accuracy.

문장표절률: **0%**

It is usually applied to tests onsmall-scalestructure, however, since it is very diffic ult to excite real-scaled structures with a shaking table.

출처표시 문장 문장표절률: **0%**

Yu et al. (2005) designed the linear shaker system to simulate earthquake respons e of a structure by em- ploying the methods both minimizing the error in time hist ories between the earthquake-induced structural responses and the linear shaker-i nduced ones and using the inverse transfer function of the responses of a structure l oaded by a linear shaker(Yu et al., 2005).

문장표절률: **100%**

However, their study is based on numerical verification, and also has several limi tations for being applied to real-scaled structures.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
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문장표절률: **100%**

First, forced vibration tests are not appropriate for utilizing the vibration source w

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문장표절률: **100%**

Especially, the structure cannot be excited to its nonline arrange, since safety may not be ensured during the test and the linear structural modelis used for the numerical simulation.

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문장표절률: **73%**

Secondly, it is inappropriate for using the vibration source with full bandwidth. Thirdly, sensors may not be sufficiently deployed in field test due to expenses and their installations so that the structural members, in which critical behaviors are expected, are detected.

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Secondly, it is inappropriate for using the vibration source withwide bandwidth. Thirdly, sensors may not be sufficiently deployed in field test due to expenses and their installations so that the structural members, in which critical behaviors are expected, are detected.

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문장표절률: **91%**

Finally, the process of obtaining the system matrix of a structure by using the system identification techniqueshould be additionally included in the entire research work, since the structure is based on an analytical model.

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문장표절률: **100%**

Accordingly, the validity of the proposed pseudo-earthquake excita- tion test needs to be experimentally investigated under these constraints.

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문장표절률: **91%**

Dyke et al. (1994) obtained controller canonical form statespace realiza- tion for a small scale three-story building by using both active mass driver and shaking table and measuring the absolute floor acceleration.

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출처표시 문장 문장표절률: **0%**

Juang (1994) proposed Observer/Kalman filter identification using system Markov parameters in time-domain. These studies present the mathematical mod- els which accurately describe input/output relationship but do not provide physical mass, stiffness, and damping matrices, finite element model based SI techniques are developed in the field of health monitoring or damagede- tection(Van der Auweraer and Peeters, 2003).

문장표절률: **0%**

Yu et al. (2005) performed a series of ambient vibration measurement and force vibration tests on four- story reinforced concrete building by using linear and eccentric mass shak- ers and updated the analytical finite element model based on the collected dynamic data.

문장표절률: **0%**

Also, Yu et al. (2005) presented a linear shaker system to 8 Chapter. 1. Introduction simulate linear elastic structural seismic response.

문장표절률: **0%**

However, because it is practically very difficult to excite large-scale civil structures by using arti- ficial actuator-type devices, SI techniques using natural excitation such as the wind, vehicle, and humanare investigated.

문장표절률: **0%**

In the most earthquake en- gineering, forced vibration testing has been implemented for many years to assess dynamic characteristics of a buildingstructure.

문장표절률: **0%**

It is based on the fact that dynamic response is sensitive to changes in mass, damping, or stiffness of a structure. These changes would lead to shifts in the modal parameters, such as natural frequencies and mode shape.

출처표시 문장 문장표절률: **0%**

The dynamic characteristics in the system to identify the integrity of a structure have also been inves- tigated(Dyke et al., 1994).

문장표절률: **0%**

The primary objective in system identification is to find the relationship between the experimental response data and the analytical model by adjusting the structural parameters in the model.

출처표시 문장 문장표절률: **0%**

1.3.3 Hybrid Testing Method on a Semi-actively Controlled BuildingStructure Equipped with Full-scale MR Dampers A wide variety of structural controlstrategies for civil engineering struc- tures such as bridges and buildings have been proposed by structural engi- neers(Adeli, 1999).

문장표절률: **0%**

Various types of active and semi-active or hybrid control dampers have also been developed to enhance the performance of passive control devices(Kim and Adeli, 2005b, a).

문장표절률: **0%**

Because semiactive control devices such as variable-orifice dampers, variable-friction dampers, and electrorhe- ological/magnetorheological (ER/MR) dampers h ave the potential to of- fer the adaptability of active devices without requiring the associated large powersources as well as the inherent stability, it is expected that t he appli- cation of a semiactive control device is one of the most promising mean s for mitigating structural response of buildingstructures under the unexpected exte rnal loads such as earthquake, wind, blast, impact, and so on.

출처표시 문장 문장표절률: **0%**

Analytical and experimental studies on these control devices when ap- plied to M R dampers have been performed in an effort to reduce the struc- tural responses, mainly due to their intrinsic stability and low power con- sumption(e.g., high dyn amic range, mechanical simplicity, environmental ro- bustness, etc.) since mid-1 990s (Dyke et al., 1994; Spencer et al., 1997).

문장표절률: **0%**

MR damper-based semiactive control systems require a feedback system con- sist ing of sensors, external power supply and controllers.

문장표절률: **0%**

Semi-active and adaptive control strategies using the MR damper have also been extensively compared and analyzed(Jansen and Dyke, 2000; Kim et al., 2009; Bit araf et al., 2010).

출처표시 문장 문장표절률: **0%**

Also a lot of control algorithms for MR damper-based semiac- tive systems have been proposed and numerically verified for control of civil engineering structures s uch as buildings and bridges by several researchers (Jansen and Dyke, 2000; Zho u et al., 2003).

문장표절률: **0%**

However, each has emphasized its advantages depending on the specific applicati on and desired effect. In order to demonstrate the pros and cons of the different co ntrol algorithms, a 9 Chapter.

문장표절률: **0%**

1. Introduction series of benchmarkstructural control problems have been develope d by the ASCE Structural Control Committee and Task Groupon Benchmark Prob - lems and International Association of Structural Control and Monitoring (IASC M).

문장표절률: **0%**

Although the benchmark problems may give us a chance to com- pare various co ntrol algorithms directly, they are only numerical simulations which cannot consi der practical limitations.

출처표시 문장 문장표절률: **0%**

In analytical studies, the Bing- ham, Bouc-Wen, and phenomenological models were proposed as analytical models for describing the hysteretic behavior of the MR damper(Spencer et al., 1997; Yang et al., 2004a).

문장표절률: **0%**

Although these models are useful in the design of the MR damper, they are inappr opriate for characterizing the be- havior of the MR damper under the excitation o f irregular loads such as earthquakes and winds because of the high nonlinearities of the MR damper due to its dependency on the loading rate and the amplitude of excitations.

출처표시 문장 문장표절률: **0%**

Also, the performance of the MR damper is not guaranteed in accordance with its current providing devices. Moreover, when the MR damper behaves as a semiacti ve control device, the hysteretic modelis unreliable when it varies with the applied current(Lee et al., 2006).

문장표절률: **0%**

For these reasons, there may be disagreement between the corresponding analytica l results and the actual responses of a building installed with an MR damper when the semi- active controlstrategy is applied.

문장표절률: **0%**

10 Chapter 2 Hybrid Testing Method In this chapter, the hybrid testing method is introduced as a classification according to equipment type.

문장표절률: **0%**

The hybrid testing method is mainly divided into shaking table experiment and U TM experiment by its equipment type. First, the hybrid testing method using the s haking table is split into the substructuring test method which tests the partial stru ctural systemsepa- rately, and the hybrid shaking tabletesting method by installin g buildingstructure with nonlinear mass typed vibration control devices such as TLD, TLCD, and TLMD.

문장표절률: **0%**

Secondly, in the case of MR damper which is a type of semi-active friction damper, it is very difficult to implement hybrid shaking tabletesting installed in an actual building.

문장표절률: **0%**

Therefore, the MR damper is installed in a universal testing machine (UTM), and a hybrid testing method isimplemented by simulating the MR damper behavior mounted in a real scaled building.

문장표절률: **0%**

This subject will consider with chapter 4. 2.1 Substructuring technique The most substructuring techniques focus on the nonlinear behavior of the lowerstories, which are selected as the experimental substructure.

문장표절률: **0%**

Accord- ingly, the upper stories are considered as the numerical substructure in those conventional substructuring techniques.

문장표절률: **0%**

Differently, from those researches, these studies address the substructuring technique for the shaking tabletest of a buildingstructure adopting the upper stories as the experimental sub- structure and the lower stories as the analytical substructure.

문장표절률: **0%**

Figure 2.1 shows the conceptual difference between the conventional and the proposed substructuring techniques as part of a hybrid testing method.

문장표절률: **75%**

The necessity of testing the upper substructure is found in diverse structures. For exam- ple, the wind-induced acceleration response of slender buildingstructures is usually tremendous in the top story, and detailed experiment for this upper part of the buildingstructure may be required, since excessive acceleration response may be harmful to human comfort or high precision equipment.

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For exam ple, the wind-induced acceleration response of slender buildingstructures is usually very large in the top story and detailed experiment for this upper part of the buildingstructure may be required, since excessive acceleration response may be harmful to human comfort or high precision equipments.

문장표절률: **100%**

Also, in some cases, a light appendage, for example, a penthouse, a small housing for mechanical equipment and an advertising billboard, may vibrate excessively rather than the primary structure.

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Also, in some cases, a light appendage, for example, a penthouse, a small housing for mechanical equipment and an advertising billboard, may vibrate excessively rather than the primary structure.

문장표절률: **44%**

Besides, to suppress excessive vibration induced by winds and earthquakes, a tuned mass damper or tuned liquid damper is employed on the top story of the high-rise building, and 11 Chapter.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Besides, to suppress excessive vibration induced by winds and earthquakes, a tuned mass damper (TMD) or tuned liquid damper (TLD) is employed on the top story of the high-rise building and its performance should be verified in the laboratory before installation.

문장표절률: **62%**

2. Hybrid Testing Method its performance should be verified in the laboratory before installation. Fi- nally, the base isolation system to protect expensive machinery housed in a buildingstructure needs experimental verification for a certain level of earthquake.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Fi nally, the base isolation system to protect expensive machinery housed in a buildingstructure needs experimental verification for a certain level of earthquake.

문장표절률: **36%**

$POUSPM 1$ TVOCVTNUSFVSDJDUVBSMF NJOFUBFTSVGBSDFFN GFPOSDU FPG PDGP BOOUS BPDM UTVJHBOUPBSM FTVYQCFTSUJSNVDFUOVUSBFM XIPMF TUSVDUVSF FYQFSJNFOUBM TZTUFN (a) conventional method FTVYQCFTSUJSNVDFUOVUSBFM TVOCVTNUSFVSDJDUBVMSF GFTFJEHCOBBDM L DTPJHOOUSBPMM TIBLJOH UBCMF $POUSPM 1$ XIPMF TUSVDUVSF FYQFSJNFOUBM TZTUFN (b) proposed method Figure 2.1: Conceptual illustrations of the substructuring methods On these backgrounds, this subsectio

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Conceptual illustrations of the real-time substructuring methods On these backgrounds, this paper proposes a shaking tabletest ing method using the upper part of a buildingstructure as the experimen tal substructure based on the acceleration feedb n proposes a shaking tabletest- ing method using the upper part of a buildingstructure as the experimen- tal substructure based on the acceleration feedback from the experimental substructure.

ack from the experimental substructure.

문장표절률: **0%**

Also, the proposed method is verified experimentally through real-time implementation. Figure 2.1 illustrates the schematic diagram of the proposed testing method in this study.

문장표절률: **76%**

At first, the interface force act- ing between the upper experimental and lower numerical substructures is calculated based on the acceleration feedback of the experimental substruc- ture which is mounted on shaking table.

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저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

At first, the interface force act ing between the upper experimental and lower numerical substructures is calculated based on the acceleration feedback of the experimental 9 2.

문장표절률: **68%**

Then the interface acceleration 12 Chapter. 2. Hybrid Testing Method required to replicate the dynamic behavior of the whole structure is calcu- lated from the numerical substructuresubjected to the interface force and assumed basemotion for the entire structure.

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저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

REAL-TIME SUBSTRUCTURING TECHNIQUEsubstructure which is mounted on shaking table. Then the interface acceleration required to replicate the dynamic behavior of the whole structure is calcu lated from the numerical substructuresubjected to the interface force and assumed basemotion for the whole structure.

문장표절률: **100%**

Finally, shaking table excites the upper experimental substructure according to the commandsignal from the shaking table controller.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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Finally, shaking table excites the upper experimental substructure according to the commandsignal from the shaking table controller.

문장표절률: **71%**

The series of above processes are performed during a single time interval and repeated over the entire duration of the experiment.

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발행 : 서울 : 단국대학교 대학원, 2007.2

The series of above processes are performed during a single time interval and repeated over entire duration of the experiment.

문장표절률: **20%**

(Measuring) Y&& 5 Y&& 4 Y&& 3 Control computer Twhthh e ei dc ihny t ni esra mn faecie e c d be a ed cc h t eol erreaptliiocna, t e whole struct avior of (Calcuulrae.ting) resfiegrneanlce Shakin Shaking table csiognntarlol (gL toaabdlei ncogn)troller Figure 2.2: Schematic diagram of the proposed method 2.1.1 Formulation and Implementation Methodology Experimental and Numerical Substructures This subsection addresses physical interpretation and formulation of split- ting the whole structure into the experimental and numerical substructures.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
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Schematic diagram of the proposed method 2.2 Formulation and Implementation Methodology 2.2.1 Experimental and Numerical Substructures This section addresses physical interpretation and formulation of split ting the whole structure into the experimental and numerical substructures.

문장표절률: **50%**

A two-step process is carried out to formulate the equations of motion for those two substructures; separating the experimental substructure from the whole structure and constructing experimental substructure mounted on the shaking table and numerical substructures with external loads on the cutting plane, as shown in Figure 2.3.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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A two-step process is carried out to formulate the equations of motion for those two substructures; separating the experimental substructure from the whole structure 10 2.

문장표절률: **35%**

The equation of motion of the whole shear-type buildingstructure sub- jected to the ground acceleration, Yg(t), is represented in Figure 2.3(a) and expressed as M Y(t) + CY(t) + KY(t) = p(t) (2.1) 13 Chapter.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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3. The equation of motion of the whole shear-type buildingstructure sub jected to the · 馨 ground acceleration, Yq (t), is represented in Fig.

문장표절률: **23%**

2. Hybrid Testing Method { where, Y(t) is the nx}1 vector of the absolute floor displacements givenby {Y1, Y2, ..., Yn}〉, and p(t) is the nx1 vector of the external force given by〉 0, ..., 0, c1Yg(t) + k1Yg(t) , M, C and K are the structural mass, damping and stiffness matrices, respectively, and expressed as follows.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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3 (a) and expressed as [M]{Y(t)}HC^ (2A) where, Y(t) is the nx₩ vector of the absolute floor displacements givenby {7PF2,···, 匕}7, and pit) is the nx₩ vector of t

he external force given by 0, 0, M C and ∣A:∣ are the structural mass, damping a nd stiffness matrices, respectively, and expressed as follows.

문장표절률: **16%**

mn M = cn cn n−1 . . . mm mm−1 . , . . m1 cn cn+cn 1 cn 1 m . . . . C = − . cm+1 cm+1+c −cm kn −kn − cm c (2.2)m+cm−1 −cm−1 . , ... −c2 c2+c1 kn kn+kn 1 kn 1 . . . . K = −km+1 k +1 m −km km km km−1 −km−1 . . .. −k2 k2+k1 The experimental and numerical substructures are separated from the whole structure by cutting at their interface, as shown in Figure 2.3(b).

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real −time hybrid test method of building structures

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mn C" − Cn − 지 Q+Q 니 −巧 · · 令 # · · · · · kn — kn n n · 參 2.2)m m −I · · · ^m −rl ' wr7J ^in − c c + c − c '·/if ^≫n−l · · · · 馨 C2+Cl− −₩이 우, r+l +^m 니L − & k + k − k · · · · · · · · · — k0 kj + ky The experimental and numerical substructures arc separated from the whole structure by cutting at their interface, as shown in Fig.

문장표절률: **100%**

Mathematically, this operation means separating the equations included in Eq. (2.1) into two groups of which one corresponds to the upper part DOF, and the other corresponds to the lower part DOF.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real −time hybrid test method of building structures

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2.3 (b). Mathematically, this operation means separating the equations included in Eq. (2.1) into two groups of which one corresponds to the upper part DOF and the other corresponds to the lower part DOF.

문장표절률: **36%**

The dotted line in Eq. (2.2) divides those two groups, and the resulting two equations of motions are written as MEYE(t) + CE(t)YE(t) + KEYE(t) = pE(t) (2.3) MN YN (t) + CN (t)YN (t) + KNYN (t) = pN (t) (2.4) where, subscripts E and N denote the experimental and numerical sub− structur} {es, respectively.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real −time hybrid test method of building structures

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The dotted line in Eq. (2.2) divides those two groups and the resulting two equations of motions are written as M e]{Yf)HC^ (2.3) 11 2. REAL−TIME SUBSTRUCTURING TECHNIQUE [Mn]{Yn}HCn]{Y^ (2.4) where, subscripts and W denote the experimental and numerical sub structur es, respectively.

문장표절률: **0%**

YE and YN are an lx1 vector given by YE(1)}, YE(2), 〉 { 〉 ..., YE(l) and an m x 1 vector given by YN(1), YN(2), ..., YN(m) , re− spectively. Accordingly, n, the length of the displacement vector, shown in Eq.

문장표절률: **0%**

(2.1) equalstom + l. Also, YE(1), YE(l), YN(1) and YN(m) in Eq.'s (2.3) and (2.4) correspond to Ym+1, Yn, Y1 and Ym in Eq. (2.1), respectively. The mass, damping and stiffness matrices and the external force vectors in 14 Chapter.

문장표절률: **0%**

2. Hybrid Testing Method Eq. (2.3) and (2.4) are expressed as follows. E(l) m M E = E(l−1) . . . , mE(2) mE(1) cE(l) −c E(l) −cE(l) cE(l)+cE(l−1) −cE(l−1) CE = ... , (2.5) (3) cE −cE 3)+cE(2) −cE(2) −cE(2) cE(2)+cE(1) k E(l) −kE(l)−kE(l) kE(l K E =)+kE(l−1) −kE(l−1).

문장표절률: **0%**

. .. . −kE(3) kE(3)+kE(2) −kE(2) −kE(2) kE(2)+kE(1) (m) mN MN = N(m−1) . . . , mN(2) mN(1) c (m) −c N N(m) −cN(m) cN(m)+cN(m−1) −cN(m−1) CN = ... , (2.6) (3) cN −cN (3)+cN(2) −cN(2) −cN(2) cN(2)+cN(1) kN(m) −kN(m) −1) −kN(. . −kN(m) kN(m)+kN(m . −1) . . . . −kN(3) kN(3)+kN(2) −kN(2) { −kN(2) kN(2})+kN(1)〉 pE(t) = 0, ..., 0, cE(1)YN(m) + kE(1)YN(m) (2.7) { ( ) ( ) pN (t) = cE(1) YE(1) − YN(m}) + kE(1) YE(1) − YN(m) , 0, ...〉 (2.8) , 0, c1Yg(t) + k1Yg(t) It is obvious from Eq.

문장표절률: **100%**

(2.7) that the absolute acceleration of the top story of the numerical substructureacts as the ground acceleration of the experi− mental substructure given by Eq.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

Concept of the proposed method It is obvious from Eq. (2.7) that the absolute acceleration of the top story of the numerical substructureacts as the ground acceleration of the experi mental substructure given by Eq.

문장표절률: **63%**

(2.3). This condition is physically realized by synchronizing the shaking tablemotion with the absolute acceleration of the top story of the numerical substructure.

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저자 : 박은천
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(2.3). This condition is physically realized by syiicluomzing the shaking tablemotion with the absolute acceleration of the top story of the numerical substructure.

문장표절률: **14%**

Besides, the first element of the external force vector in Eq. (2.8) means the interface force acting on the top 15 Chapter. 2. Hybrid Testing Method) Y m E(l) (t E(l) Y m E(l) (t) E(l) E(l□1)(t) mE(l□1) YE(l□1)(t) mE(l□1) esuxbpsetrriumcetun

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
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rtael) YE(1)(t mE(1) Yn(t) mn cutting at YE(1)(t) mE(1) YN(m)(t) m)(t Yn□1(t) Y mn□1 m N(N(m) Y m N(m) (t) N(m) N(m□1)(t) Y m2(t) N(m□1) m2 YN(m□1)(t) numerical mN(m□1) YN(1)(t) YN(1)(t) Y1(t) m1 mN(1) Yg(t) Yg(t) m N(1) Yg(t) (a) Whole struc- (b) Separation of whole (c) Experimental and numerical sub- ture structurestructure Figure 2.3: Concept of the proposed methodstory of the numerical substructure.

Besides, the first element of the external force vector in Eq. (2.8) means the interface force acting on the top story of the numerical substructure.

문장표절률: **100%**

This interface force, which is denoted by i(t) from now on, is produced by the damping and restoring forces of the first story in the upper(experimental su)bstructu(re andrewritte)n as follows.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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(2.8) means the interface force acting on the top story of the numerical su bstructure. This interface force, which is denoted by i(t) from now on, is produced by the damping and restoring forces of the first story in the upper experimental su bstructu re andrewritte n as follows.

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저자 : 박은천
발행 : 서울: 檀國大學校, 2006

This interface force, which is denoted by i(t) from now on, is produced by the damping and restoring forces of the first story in the upper experimental su bstructu re andrewritte n as follows.

문장표절률: **39%**

i(t) = cE(1) YE(1) - YN(m) + kE(1) YE(1) - YN(m) (2.9) As a result, the numerical substructure, of which equation of motion is given by Eq. (2.4), is subjected to both the interface force at the top story and the ground motion at the base.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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(2.4), is subjected to both the interface force at the top story and the ground motion at the base. The boundary condition and external load of each substructure are illustrated in Fig.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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(2.4), is subjected to both the interface force at the top story and the ground motion at the base. The boundary condition and external load of each substructure are illustrated in Fig.

문장표절률: **38%**

The boundary condition and external load of each substructure are illustrated in Figure 2.3(c). Measurement of the interface force In this section, the interface force, i(t), which should be fed-back to the nu- merical substructure for calculating the interface acceleration, is indirectly measured by the accelerometers attached on the experimental substructure, as shown in Figure 2.1.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

2.3 c). 2.2.2 Measurement of the interface force In this study the interface force, i t), which should be fed-back to the nu merical substructure for calculating the interface acceleration, is indirectly measured from the accelerometers attached on the experimental substructure, as shown in Fig.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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2.3 c). 2.2.2 Measurement of the interface force In this study the interface force, i(t), which should be fed-back to the nu merical substructure for calculating the interface acceleration, is indirectly measured from the accelerometers attached on the experimental substructure, as shown in Fig.

문장표절률: **100%**

Dynamic equilibrium in the experimental substruc- ture is applied to derive the interface force using acceleration response mea- surement of the experimental substructure.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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2.2. Dynamic equilibrium in the experimental substruc ture is applied to derive the interface force using acceleration response mea surement of the experimental substructure.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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2.2. Dynamic equilibrium in the experimental substruc ture is applied to derive the interface force using acceleration response mea surement of the experimental substructure.

문장표절률: **80%**

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

As shown in Figure 2.4, dynamic equilibrium in the experimental substructure is established between the in- terface force acting at its base and the resultant of its inertial forces, because internal forces between each story are canceled with each other.

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

As shown in Fig. 2.4, dynamic equilibrium in the experimental substructure is established between the in terface force acting at its base and the resultant of its inertial forces, because internal forces between each story are cancelled with each other.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

As shown in Fig. 2A, mic equilibrium in the experimental substructure is established between the in terface force acting at its base and the resultant of its inertial forces, because internal forces between each story are cancelled with each other.

문장표절률: **57%**

This relation can be derived in another way. First, the dotted parts are shown in Eq. (2.5) aremoved to the rightside of Eq. (2.3). Then therelation of Eq.

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저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

This relation can be derived in another way. First, the dotted parts shown in Eq. (2.5) aremoved to the rightside of Eq. (2.3). Then therelation of Eq.

문장표절률: **44%**

(2.9) is 16 Chapter. 2. Hybrid Testing Method applied to the rightside. Finally, the summation of l simultaneous equations for each side gives following expression of the interface force, i(t).

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저자 : 박은천
발행 : 서울: 檀國大學校, 2006

(2.9) is applied to the rightside. Finally, the summation of I simultaneous equations for each side gives following expression of the interface force, i t) · /(0=-Sm£(/) ^(/) (2-10) /=i Eq.

문장표절률: **72%**

Σl i(t) = – mE(i)ΥE(i) (2.10) i=1 Eq. (2.10) physically implies that the interface force, which is required as an input data of the numerical substructure, can be calculated using the measured acceleration responses of the experimental substructure.

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저자 : 박은천
발행 : 서울: 檀國大學校, 2006

(2.10) physically implies that the interface force, which is required as an input data of the numerical substructure, can be calculated using the measured acceleration responses of the experimental substructure.

문장표절률: **0%**

m ÎE(l)YÎE(l) c ÎE(l)YE(l) + kE(l)YE(l) m ÎÎE(l□1)YE(l□1) cE(l□1)YÎE(l□1) + kE(l□1)YE(l□1) UUGUGG cE(2)Y Î E(2) + kE(2)YE(2) m ÎÎE(1)YE(1) c ÎE(1)YE(1) + kE(1)YE(1) i(t) Figure 2.4: Dynamic equilibrium in experimental substructure Calculation of the numerical substructure The calculation of the numerical substructureshown in Figure 2.1 means on-line time history analysis of the Eq.

문장표절률: **0%**

(2.4) that represents the dynamic equilibrium of the numerical substructureshown in Figure 2.3(c). To inte- grate this analysis procedure with shaking table control process implemented on a digital computer, Eq.

문장표절률: **0%**

(2.4) is transformed into state-space equations. Thestate-space equations, of which the output is the absolute accelerations of the numerical substructure, are given by the following equations in the continuous time domain.

문장표절률: **0%**

ż(t) = Az(t) + Bu(t) (2.11) O(t) = Cz(t) + Du(t) where, z(t) is the 2mx1 vector of state variables composed of the relative displacement and velocity of the{numerical }substructure.

문장표절률: **88%**

u(t) is the 2 x 1〉 vector of input variables given by i(t), Ϋg(t) , in which the interface force, i(t), is fed-back from the experimental substructure using Eq.

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{u(t) is the 2 x 1 vector of input variables given by {/(r), YAt)}1 , in which the interface force, i(t), is fed-back from the experimental substructure using Eq.

문장표절률: **48%**

(2.10). O(t) 17 Chapter. 2. Hybrid Testing Method is the mx 1 vector of the output composed of the absolute accelerations of the numerical substructure.

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발행 : 서울: 檀國大學校, 2006

(10). (0(/)} is the mxl vector of the output composed of the absolute accelerations of the numerical substructure. The system matrices [A], [S], [C] and [D] have the dimension of 2mx2m, 2m x 2, mx 2m and m x 2,respectively, and are expressed as [A] [0L [II (2.12) [B] {0} , {0} [A/v]>}, {-1} (2.13) [C] = [-[MNy[[K, l -[Mj-'tcj [D] = [[MN]-₩b)9 {0}] (2.14) (2.15) where, [0] and [I] are mx m zero and unit matrices, respectively, and {0} and {-1} are an mxl vector of 0 and an mxl vector respectively, {b} is an mxl vector given by {1,0, …,0}r.

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발행 : 서울 : 단국대학교 대학원, 2007.2

(10). {0(t)} is the mXl vector of the output composed of the absolute accelerations of the numerical substructure. The system matrices [A], [B], [C] and [D] have the dimension of 2m x 2m , 2m x 2, mx 2m and m x 2,respectively, and are expressed as [시 [이麻 {mny[[kni [A네] (2.12) [B] {0} , {0} [MNYl{b}9 {-1} (2.13) [C] = [-[MNT'[KNl -[M(Vr'[Cv]] [D] = [[MNTl{b}9 {0}] (2.14) (2.15) where, |0| and |7| are mxm zero and^init matrices, respectively, and {0} and {-1} are an nixl vector of 0 and an mxl vector of -1,respectively.

문장표절률: **54%**

The system matrices A, B, C and D have the dimension of 2m x 2m, 2m x 2, m x 2m and m x 2, respectively, and are expressed as = - 2)M-1 (2.1N KN -M-1N CN 0 1 B = M-1b (2.13) [[ ]]C = -M-1N KN -M-1N CN (2.14) D = M-1N b 0 (2.15) where, 0 and I are m x m zero and unit matrices, respectively, and 0 and -1 are an m x 1 vector of 0 and an m x 1 vector of -1, respectively.

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(10). {0(t)} is the mXl vector of the output composed of the absolute accelerations of the numerical substructure. The system matrices A B C and D have the dimension of 2m x 2m 2m x 2, m x 2m and m x 2, respectively, and are expressed as [시 [이麻 {mny[[kni [A네] (2.12) [B] {0} , {0} [MNYl{b}9 {-1 2.13) C MNT'[KNl -[M(Vr'[Cv]] [D] = [[MNTl{b}9 0 2.14) (2.15) where, 0 and |7| are m x m zero and^init matrices, respectively, and 0 and 1 are an nixl vector of 0 and an m xl vector of -1, respectively.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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(10). (0(/)} is the mxl vector of the output composed of the absolute accelerations of the numerical substructure. The system matrices A], [S], C and D have the dimension of 2m x 2m, 2m x 2, m x 2m and m x 2, respectively, and are expressed as [A] [0L [II (2.12) [B] {0} , {0} [A/v]>}, {-1 2.13) C MNy[[K, l -[Mj-'tcj [D] = [[MN]-₩b)9 0 2.14) (2.15) where, 0 and I are m x m zero and unit matrices, respectively, and 0 and 1 are an m xl vector of 0 and an m xl vector respectively, {b} is an m xl vector given by {1,0, …,0}r.

문장표절률: **44%**

b is an m x 1 vector given by {1, 0, ..., 0}〉. Eq. (2.11) with the inputs of the interface force and ground motion is incorporated in the 'Calculating' part shown in Figure 2.1, and produces the absolute acceleration responses of the numerical substructure on-line.

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{/?} is an m xl vector given by {1, 0,…,0}7 Eq. (2 11) with the inputs of the interface force and ground motion is incorporated in the 'Calculating' part shown in Fig.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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Eq. (2 11) with the inputs of the interface force and ground motion is incorporated in the cCalculating' part shown in Fig.

문장표절률: **100%**

Among those acceleration responses, theone corresponding to the top story is utilized as the reference signal to operateshaking table.

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2.2, and produces the absolute acceleration responses of the numerical substructure online. Among those acceleration responses, theone corresponding to the top story is utilized as the reference signal to operateshaking table.

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발행 : 서울: 檀國大學校, 2006

2.2, and produces the absolute acceleration responses of the numerical substructur e online. Among those acceleration responses, theone conesponding to the top story is utilized as the reference signal to operateshaking table.

문장표절률: **86%**

2.1.2 Numerical Substructure For the verification experiment of the proposed methodology, the objectstructure is assumed to be a five-story shear type buildingstructure, of which two upper stories are assumed to be the experimental substructure as shown in Fifure 2.15.

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It is observed that they agree well with each other. 20 2. REAL-TIME SUBSTRUCTURING TECHNIQUE 6 8 10 12 16 18 20 (Deg.) o ·100 ·200 ·300 ·400 0 2 4 6 8 10 12 14 16 18 20 Frequency (Hz) Figure 2-9· Compensation result for the dynamic characteristic of shaking table 2.3.3 Numerical Substructure For the verification experiment of the proposed methodology, the objectstructure is assumed to be a five-story shear type buildingstructure, of which two upper stories are assumed to be the experimental substructure as shown in Fig.

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Compensation result for the dynamic characteristic of shaking table 2.3.3 Numerical Substructure For the verification experiment of the proposed methodology, the objectstructure is assumed to be a five-story shear type buildingstructure, of which two upper stories are assumed to be the experimental substructure as shown in Fig.

문장표절률: **100%**

As a result, the numerical substructure is the three lowerstories of the whole structure. For the construction of the finite element model of the numerical substructure, the inter-story damping and stiffness coefficients of the shear-type experimental substructure are identified based on the measured acceleration responses, and the mass of the two floors are measured directly.

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2.8. As a result, the numerical substructure is the three lowerstories of the whole structure. For the construction of the finite element model of the numerical substructure, the inter-story damping and stiffness coefficients of the shear-type experimental substructure are identified based on the measured acceleration responses and the mass of the two floors are measured directly.

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2.8. As a result, the numerical substructure is the three lowerstories of the whole structure. For the construction of the finite element model of the numerical substructure, the inter-story damping and stiffiess coefficients of the shear-type experimental substructure are identified based on the measured acceleration responses and the mass of the two floors are measured directly.

출처표시 문장 문장표절률: **0%**

The system identification of the experimental substruc- ture is conducted using the command fmincon in MATLAB(Coleman et al., 1999), which uses the interior-reflective Newton method to solve the con- strained nonlinear minimization problem (Coleman, 1994; Coleman and Li, 1996).

문장표절률: **0%**

Resulting identified parameters can be summarized as follow. mE(1) = m4 = 2.04 (kg), mE(2) = m5 = 5.10(kg) kE(1) = k4 = 45.3(N/m), kE(2) = k5 = 48.5(N/m) (2.16) cE(1) = c4 = 0.023(N · s/m), cE(2) = c5 = 0.015(N · s/m) which correspond to the firstandsecond natural frequencies of 2.5 and 8.6Hz, respectively, as given in Table 2.1.

문장표절률: **0%**

Figure 2.5 compares the exper- 18 Chapter. 2. Hybrid Testing Method imentally obtained transfer functions with numerically computed ones.

문장표절률: **0%**

As shown in Figure 2.5, measured transfer functions agree well with those of the corresponding numerical model. TU TUPSZ TIBLJOH UBCMF 2 ' SFRVFODZ) [OE TUPSZ TIBLJOH UBCMF ' SFRVFODZ) ['SFRVFODZ SFTQPOTF 'SFRVFODZ SFTQPOTF .*EFFBOTUVJ SFFEE .*EFFBOTUVJ SFFEE Figure 2.5: Comparison of experimental and approximated transfer func- tions.

문장표절률: **29%**

Table 2.1: Frequencies observed in the time records of the experimental substructure from the test without feedback and the natural frequencies of the assumed whole structure Mode Frequency compo- Natural frequencies nents(Hz) observed (Hz) of the whole in the experimental structure with 5 DOFs substructure with 2 DOFs 1 1.3 1.3 2 2.5 4.2 3 4.2 7.1 4 7.1 9.4 5 8.6 10.8 The structural parameters for the first story of the experimental struc- ture given in Eq.

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Table 2 1 Frequencies observed in the time records of experimental substructure from the test without feedback and natural frequencies of the assumed whole structure Mode Frequency components Hz) observed in the experimental substructure wit h 2 DOFs Natural frequencies (Hz) of the whole structure with 5 DOFs 1 1.3 1.3 2 2.5 4.2 3 4.2 7.1 4 7.1 9.4 5 8.6 10.8 26 2.

문장표절률: **26%**

(2.16) are applied to all stories of the numerical substruc- ture and summarized a s the following: 19 Chapter. 2. Hybrid Testing Method i(t) =-mE(1)YE(1)(t)-mE (2)YE(2)(t) (2.17) - + i(t) (2.18) YN(3)(t) =- cN(3) YN(3) - YN(2) N(3) YN(3) - YN(2) Eq.

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(2.18) are applied to all stories of the numerical substruc ture and summarized as the following: mN(l) = m, = 2.04, mjV(2) = m2 = 2.04, mV(3) = m3 = 2.04 (kg) ^V(l) =k₩= 45.3, kN{2) =k2= 45ㄱ, *..V(3) = h = 45-3 (N/m) cN{l) =c, = 0.02 3,cN{2) =c2 = 0-023,c勵 = c3 = 0.023 (N · s/m) With these parameters for the n umerical substruc tures the interface force interface acceleration can be written as follows.

문장표절률: **93%**

(2.18) means that the interface force, which is produced by the shak- ing table, is calculated using the two measured absolute accelerations of the experimental subs tructure.

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l'(0 = ~fnE(])Y, m (0 - mE{2)YEi2) (t) · · · · 차V(3)(0 - _CiV(3)(^V<3) - ^/V(2)) _ ^N(3)^V(3) _ + , ·(1) Eq. (2.20) means that the interface force, which is produ ced by the shak ing table, is calculated using the two measured absolute accelerati ons of the experimental substructure.

문장표절률: **39%**

Then, the interface acceleration is calculated from the numerical substructure expr essed by Eq. (2.11). Figure 2.6 repre- sents the block diagram of the entire substr ucturing testing system including the numerical substructure marked by the shaded area.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

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Then, the interface acceleration is calculated from the numerical substructure expr essed by Eq. (2.11) Fig. 2.11 repre sents the block diagram of entire real-time sub structuring experimental system including the numerical · 參 substructure marked by the shaded area.

문장표절률: **77%**

In Figure 2.6, the ground acceleration, Yg, is not a measured signal but an input d ata pre- scribed by a user. Finally, the shaking tablemotion is controlled using the inverse transfer function of Eq.

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In Fig. 2.11, the ground acceleration, Y{f, is not a measured signal but an input d ata pre scribed by a user. Finally, the shaking tablemotion is controlled using the i nverse transfer function of Eq.

문장표절률: **62%**

(2.36) to minimize the errors between the interface acceleration computed as the t hirdstory absolute acceleration of the numerical substructure, YN(3), and the actu al shaking table accelera- tion.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

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(2J7) to minimize the errors between the interface acceleration computed as the th irdstory absolute acceleration of the numerical substructure, ^V(3), and the actual shaking table accelera tion.

문장표절률: **0%**

Therefore, the shaking table itself works as the interface node of Fig- ure 2.3(b) a nd excites the upper experimental substructure.

문장표절률: **0%**

In the actual implementation of the shaking tabletest, the continuous filters include d in Figure 2.6 are converted into discrete filters with a time step of 0.01 sec.

문장표절률: **0%**

Control computer (LabVIEW) Y&&N (1) G Dynamics of Y && N (2) G 5 D.O.F s system &z&0 (t) G U&&N (1) G U&& &y&N (2) G N (1) G cs of ystem Y&& Dynami m E (2) G E (2) G -m 3 D.O.Fs sE (2) G cE (2) , kE (2) G m 2N (1) · s + cN (1) · s + kN (1) - G U&& &y&N (3) G N (2) G m 2N (3) · s 2) G Y&&E (1) G E (1) G -mE (1) G N (- N (3) G 1 m force, i(t) cE (1) , kE (1) G Y&&E (0) G N (3) Y&&N (3) G rface eration control Inverse Transfer FunctionShaking ta ble signal of Shaking Table, G-1(s) Figure 2.6: Block diagram of the integrated c ontroller for the substructuring testing system.

문장표절률: **0%**

2.2 Hybrid Testing Method for the Performance Evaluation of a Tuned Liquid Da mper In this section, the vibration control effect of a TLD for a buildingstruc- ture excited by earthquake load is experimentally evaluated through the hy- brid testi ng method.

출처표시 문장 문장표절률: **0%**

The hybrid testing method does not require a physical 20 Chapter. 2. Hybrid Testing Method buildingstructural model in performing the experiment of a TLD-structure interactionsystem, and it only uses a TLD which is known to have strong nonlinearity dependent on response amplitude, excitation frequency, and depth to length ratio(Yu et al., 1999).

문장표절률: 0%

The structural responses of the in- teractionsystem are calculated numerically in real time using the analytical structural model with the excitations of measured control force, user-defined base earthquake loads, and its statespace realization incorporated in the in- tegrated controller of the shaking table.

문장표절률: 0%

Also, in order to minimize the distor- tion of the acceleration of the shaking table, the inverse transfer function of the shaking table is identified, and its statespace realization isimplemented in the shaking table controller.

문장표절률: 0%

Themotion of shaking table behaves both the controlled and uncontrolled absolute acceleration of the TLD mounted floor by modulating the feedback gain of the shear force measured by the load cell installed between the TLD and the shaking table.

문장표절률: 40%

Comparison be- tween the structural responses obtained by the hybrid testing method and the conventional shaking tabletest of a single story steel frame with TLD is made in order to verify the accuracy of the hybrid testing method and the uncontrolled and TLD-controlled structural responses of a three-story struc- ture are obtained by the hybrid testing method in both time and frequency domains.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Comparison be tween the structural responses obtained by the RHSTTM and the conventional shaking tabletest of a single story steel frame with TLD/TLCD is made in order to verify the accuracy of the RHSTTM and the uncontrolled and TLD/TLCD-controlled structural responses of a three story struc ture are obtained by the RHSTTM in both time and frequency domains.

문장표절률: 55%

2.2.1 Hybrid Testing Method with TLD Figure 2.7 depicts the conceptual illustrations of the hybrid testing method for an n-degrees-of-freedomstructural model which is excited by base ac- celeration and has a tuned liquid damper at its top story.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

3.1 depicts the conceptual illustrations of the RHSTTM for an n-degrees-of-freedomstructural model which is excited by base ac celeration and has a tuned liquid damper at its top story.

문장표절률: 90%

First, the whole control system is separated into the lower part structure, and the upper part TLD and the interaction force between the structure and TLD are consid- ered.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

First, the whole control system is separated into the lower part structure, and the upper part TLD and the interaction force between the structure and TLD is consid ered The TLD with the interacting force at its bottom is physically tested and the response of the structure withinteracting force at the top floor and the base acceleration is numerically calculated by using the computer controlling motion of the shaking table.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

First, the whole control system is separated into the lower part structure, and the upper part TLD and the interaction force between the structure and TLD is consid ered.

문장표절률: 88%

The TLD with the interacting force at its bottom is physically tested, and the response of the structure withinteracting force at the top floor and the base acceleration is numerically calculated by using the computer con- trolling themotion of the shaking table.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

First the whole con trol system is separated into the lower part structure, and the upper part TLD and the interaction force between the structure and TLD is considered The TLD with the interacting force at its bottom is physically tested and the response of the structure withinteracting force at the top floor and the base acceleration is numerically calculated by using the computer con trolling motion of the shaking table.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

The TLD with the interacting force at its bottom is physically tested and the response of the structure withinteracting force at the top floor and the base acceleration is numerically calculated by using the computer con trolling motion of the shaking table.

문장표절률: **88%**

Measurement of interacting force is easily accomplished by installing a shear-type load-cell at the bottom of the TLD, as shown in Figure 2.7.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

Measurement of interacting force is easily accomplished by installing a shear-type load-cell at the bottom of the TLD, as shown in Fig.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Measurement of interacting force is easily accomplished by installing a shear-type load-cell at the bottom of the TLD, as shown in Fig.

문장표절률: **100%**

TLD-generated shear force is fed back to the control computer. With this fed-back interacting force, the structural response of the story, where a TLD is installed, is calculated using the nu- merical part.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

3.1. TLD-generated shear force is fed back to the control computer. With this fed-back interacting force, the structural response of the story, where a TLD is installed, is calculated using the nu merical part The shaking table excites the upper TLD according to this calculated response.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

3.1. TLD-gcncratcd shear force is fcd back to the control computer. With this fed-back interacting force, the structural response of the story, where a TLD is installed, is calculated using the ^pmerical part.

문장표절률: **45%**

The shaking table excites the upper TLD according to this calculated response. This process is carried out on real-time. The numerical part with n-DOFs, which is subjected to the excitations of the measured control force, ie(t), and the input acceleration, ž0(t), at its top and bottom, respectively, as enclosed in dotted line in Figure 2.7, is calculated by MŸi(t) + CYi(t) + KYi(t) = p(t) (2.19) 21 Chapter.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

Concept of the real-time hybrid testing method (TLCD) Of theses procedures the numerical part with n-DOFs, which is subjected to the excitations of the experimentally measured control force, /, (t), and the input acceleration, z0(/), at its top and bottom, respectively, as enclosed in dotted line in Fig.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

The shaking table excites the upper TLD according to this calculated response. This process is carried out on real-time. Figure 3-1.

문장표절률: **15%**

2. Hybrid Testing Method assessing TLD TLD Experimental Part TLD i(t) Y (t) n m Y (t) n m n n Y (t) Cutting at n-1 m TLD interface Y (t) n-1 n-1 m n-1 sensing Shaking Table i(t) Numerical Part Y (t) Y (t) 1 1 m m 1 1 &z& (t) &z& (t) &z& (t) 0 0 0 shear type load cell &z& (t) &z& (t) 0 0 Figure 2.7: Conceptual view of the hybrid shaking tabletest where, Yi(t) is the absolute displacement at the ith(i = 1→ n) story, and the location vector of external forces with the length of n, p(t) equals to {-ie(t), 0, ..., 0, c1ż0(t) + k1z0(t)}⟩, in which subscript "e" denotes the "ex- perimentally" measured interacting force.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

4.1 Js calculated by [M]{^(r)} + [C]{^.(r)} + [^{l:.(r)} = {p(r)} (4.1) where, 예0} is the absolute displacement at the ith(i = l~/i) story, and the location vector of external forces with the length of n p(t) equals to ie(t), 0, c₩z0(t) + k]z0(t)}/ · Also, the structural mass, damping and stiffness matricesare represented by [M] = mn m n -1 , [C] = c -c n - Cn , [K] = ' K -K ' ~kn kn + knA - Vl · · .

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

4.1,is calculated by [A/]{^(0} + [C]{^(0} + [^]{^(0} = {^(0} (4.1) where, is the absolute displacement at the / th(/ = 1 ~ a? story, and the location vector of external forces with the length of n, p(t) equals to {-/·XO, ☐, ···, ☐, c, z0(t) + k{z0(t)}r.

문장표절률: **0%**

Also, the structural mass, damp- ing and stiffness matricesare represented by c-nc n cn mn-1 M = . , C =.. m1 cn cn-1 -cn-1 . . . . .c2 c2+c1 (2.20)kn-kn kn K = kn kn-1 -kn-1 .

문장표절률: **0%**

. .. . −k2 k2+k1 To calculate the numerical part such as Eq. (2.20) by a cont rol computer on real−time, it is transformed into thestate−space representation giv en by ż(t) = Acz(t) + Bcu(t) (2.21) O(t) = Ccz(t) + Dcu(t) where, thestate variable vector, z(t), with the length of 2n comprises thestate variables, {yi(t), ẏi(t)}〉, in w hich the structural relative displace− ment, yi(t), equals to Yi(t)− z0(t).

문장표절률: **0%**

The input vector, u(t), with the length of 2 consists of {−ie(t), z̈0}〉. The output ve ctor, O(t), with the length of n corresponds to the structural absolute acceleration, Ÿi(t), itself.

문장표절률: **0%**

The matri− ces Ac, Bc, Cc and Dc with the sizes of 2nx 2n, 2nx 2, nx 2n and nx 2 , respectively, are expressed as the following Eqs. (2.22)−(2.25).

출처표시 문장 문장표절률: **0%**

22 Chapter. 2. Hybrid Testing Method [ ] 0 A mxc = n Imxn M−1 (2.22)K M−1C [0 B nx1c = M−1b] 0nx1 (2.23) 1 [[Cc = −M−1K −M−]1C (2.24) Dc = M −]1 b 0mx1 (2.25) 2.3 Hybrid testing method for the Performance Evaluation of a Tu ned Liquid Column Damper The tuned liquid column damper has received the att ention of researchers as a type of auxiliary mass system(Samali et al., 1998).

문장표절률: **0%**

TLCD has the control characteristics similar to that of tuned mass damper, which is one of most frequently used dampers for vibration control.

출처표시 문장 문장표절률: **0%**

Since the viscosity term in the governing equation of motion of TLCD is a functio n of the absolute value of liquid velocity, the equation is nonlinear, and the dyna mic characteristics of TLCD depend on the magnitude and the characteristics of e xcitation forces and the corresponding structural responses of the floor at which T LCD is installed(Yalla, 2001).

문장표절률: **76%**

In this section, the vibration control effect of a TLCD for a buildingstructure excit ed by earthquake load is experimentally evaluated through the hybrid testing met hod.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

In this paper, the vibration control effect of a TLCD for a buildingstructure excite d by earthquake load is experimentally evaluated through the real−time hybrid sh aking tabletesting method (RHSTTM).

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real −time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

In this paper, the vibration control effect of a TLCD for a buildingstructure excite d by earthquake load is experimentally evaluated through the real−time hybrid sh aking tabletesting method (RHSTTM).

문장표절률: **77%**

The hybrid testing method does not require a physical buildingstructural model in performing the experiment of a TLCD−structure interactionsystem, and it only use s a TLCD.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real −time hybrid test method of building structures

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발행 : 서울 : 단국대학교 대학원, 2007.2

The RHSTTM does n't require a physical buildingstructural model in performing t he experiment of a TLCD−structure interactionsystem and it only uses a TLCD.

문장표절률: **100%**

The structural responses of the interactionsystem are calculated numerically in rea l time using the analytical structural model with the excitations of measured contr ol force, user−defined base earthquake loads, and its statespace realization incorp orated in the integrated controller of the shaking table.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

The structural responses of the interactionsystem are calculated numerically in rea l time using the analytical structural model with the excitations of measured contr ol force, user−defined base earthquake loads, and its statespace realization incorp orated in the integrated controller of the shaking table.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시

스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

The structural responses of the interactionsystem are calculated numerically in real time using the analytical structural model with the excitations of measured control force, user-defined base earthquake loads, and its statespace realization incorporated in the integrated controller of the shaking table.

문장표절률: **100%**

Also, in order to minimize the distortion of the acceleration of the shaking table, the inverse transfer function of the shaking table is identified, and its statespace realization isimplemented in the shaking table controller.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

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저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Also, in order to minimize the distortion of the acceleration of the shaking table, the inverse transfer function of the shaking table is identified and its statespace realization isimplemented in the shaking table controller.

문장표절률: **37%**

The shaking table behaves as the absolute acceleration of the TLCD mounted floor by calculating the fed back signal of the shear forcesignal measured by the load cell positioned between the TLCD and plate of the shaking table.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

The shaking table reproduces the absolute acceleration of the TLCD installed floor by modulating the feed back gain of the shear forcesignal measured by the load cell positioned between the TLCD and the shaking table.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

The shaking table reproduces the absolute acceleration of the TLCD installed floor by modulating the feed back gain of the shear forcesignal measured by the load cell positioned between the TLCD and the shaking table.

문장표절률: **31%**

Comparison results between the structural responses obtained by the hybrid testing method and the conventional shaking tabletest of a single story steel frame with TLCD are made to verify the accuracy of the hybrid testing method in both time and frequency domains.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

Comparison between the structural responses obtained by the RHSTTM and the conventional shaking tabletest of a single story steel frame with TLCD is made in order to verify the accuracy of the RHSTTM in both time and frequency domains.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Comparison between the structural responses obtained by the RHSTTM and the conventional shaking tabletest of a single story steel frame with TLCD is made in order to verify the accuracy of the RHSTTM in both time and frequency domains.

문장표절률: **0%**

23 Chapter. 2. Hybrid Testing Method 2.3.1 Hybrid Testing Method with TLCD Figure 2.8 shows the conceptual view of the experiment.

문장표절률: **100%**

The whole struc- tural control system, which a TLCD was installed onto the structural model with n-degrees-of-freedom at its top story, is separated, and as the result of that, the force interacts at their interface.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

4.2 Real-Time Hybrid Shaking TableTesting Method with TLCD Fig. 1 shows the conceptual view of the experiment. The whole struc tural control system, which a TLCD was installed onto the structural model with n-degrees-of-freedom at its top story, is separated, and as the result of that, the force interacts at their interface.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

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문장표절률: **98%**

The upper part of TLCD with the interacting force at its bottom is physically teste d and the lower part of the structural model with the interacting force and the inp ut motion at its top story and base, respectively, is numerically calculated within t he computer to control themotion of shaking table.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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문장표절률: **100%**

For the experimental implementa- tion, interacting or control force generated by a TLCD, which is observed from a load-cell, is fed back to the control computer.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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For the experimental implementa tion, interacting or control force generated by a TLCD, which is observed from a load-cell, is fed back to the control computer.

문장표절률: **100%**

With the fed-back interacting force, the structural response of the story, where a TLCD is in- corporated, is calculated from the numerical part.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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With the fed-back interacting force, the structural response of the story, where a TLCD is in corporated, is calculated from the numerical part.

문장표절률: **14%**

The shaking table excites the upper TLCD with this calculated response. These pr ocesses are carried out on real-time. 5VOFE -JRVJE $PMVNO %BNQFS i & BT TFTTJOH1YBQSUFSJNFOUBM TFOTJOH 4IBLJOH 5BCMF t) Yn(t) Yn(t) mn mn i(t) Yn□1(t) n□1 5-$$V%UU JJOOUHF BSGUB DF Yn□1(t) mn□1 1/BVS NU FSJDBM TIFBS UZQF MPBE DFMM Y1(t) Y1(t) m1 m1 z0(t) z0(t) z0(t) z0(t) z0(t) Figure 2.8: Concept of the hybrid testing method (TLCD) Of theses proced ures, the numerical part with n-DOFs, which is sub- jected to the excitations of t he experimentally measured control force, ie(t), and the input acceleration, z̈0(t), at its top and bottom, respectively, as enclosed in dotted line in Figure 2.8, is calc ulated by MŸi(t) + CŸi(t) + KYi(t) = p(t) (2.26) where, Yi(t) is the absolute displ acement at the ith(i = 1→ n) story, and the location vector of external forces with the length of n, p(t) equals to {-ie(t), 0, ..., 0, c1ż0(t) + k1z0(t)}〉, in which subscr ipt "e" denotes the "ex- perimentally" measured interacting force.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

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Concept of the real-time hybrid testing method (TLCD) Of theses procedures, the numerical part with n-DOF$, which is sub jected to the excitations of the experim entally measured control force, ijj), and the input acceleration, z()(0, at its top an d bottom, respectively, as enclosed in dotted line in Fig.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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Concept of the real-time hybrid testing method (TLCD) Of theses procedures, the numerical part with n-DOFs, which is sub jected to the excitations of the experim entally measured control force, /, (t), and the input acceleration, z0(/), at its top and bottom, respectively, as enclosed in dotted line in Fig.

문장표절률: **0%**

Also, the structural mass, damp- 24 Chapter. 2. Hybrid Testing Method ing and s tiffness matricesare represented by [m cn -cn m - n c n-1 n cn M = , C = .

문장표절률: **0%**

. . m1 . . . . c2 c2+c1 (2.27) kn −kn kn K = kn kn−1 −kn−1 . . . . −k2 k2+k1 To calculate the numerical part such as Eq. (2.20) by a control computer on real−time, it is transformed into thestate−space representation given by ż(t) = Acz(t) + Bcu(t) (2.28) O(t) = Ccz(t) + Dcu(t) where, thestate variable vector, z(t), with the length of 2n comprises thestate variables, {yi(t), ẏi(t)}〉, in which the structural relative displace− ment, yi(t), equals to Yi(t)− z0(t).

문장표절률: **0%**

The input vector, u(t), with the length of 2 consists of {−ie(t), z̈0}〉. The output vector, O(t), with the length of n corresponds to the structural absolute acceleration, Ÿi(t), itself.

문장표절률: **0%**

The matri− ces Ac, Bc, Cc and Dc with the sizes of 2nx 2n, 2nx 2, nx 2n and nx 2, respectively, are expressed as the following Eqs. (2.29)−(2.32).

문장표절률: **0%**

[ ] 0 Ac = mxn Imxn (2.29) M−1K M−1C [0 Bc = nx1 −1] 0nx1 (2.30) [[C 1c = −M− K −M] −]1C (2.31) Dc = M −1b 0mx1 (2.32) where, 0nxn and Inxn are the zero and unit matrices, respectively, with the size of nx n.

문장표절률: **0%**

0nx1 and −1 are the vector whose components are 0 and −1, respectively, with the length of nx 1. b equal to {1, 0, ..., 0}〉 with the length of nx 1.

출처표시 문장 문장표절률: **0%**

2.4 Hybrid Testing Method for the Performance Evaluation of a Tuned Liquid Mass Damper In previous study(Heo et al., 2009), a new control device, which is called tuned liquid mass damper (TLMD), was developed and discussed in this section.

문장표절률: **0%**

The dynamic characteristics of a TLMD used in this study are that its mass is composed of both a mass of TLCD frame itself and that of liquid 25 Chapter.

문장표절률: **0%**

2. Hybrid Testing Method in a tank. Natural rubber columns were used to substitute the stiffness of a TMD. Therefore, a TLMD operates as a TLCD in one direction and behaves as a TMD in the other orthogonal direction.

문장표절률: **0%**

In this section, the control performance of the proposed TLMD for reduc− ing bidirectional responses of buildingstructures is experimentally verified through both a conventional structural testing method and hybrid testing method.

문장표절률: **0%**

First, the control performance of a TLMD is evaluated by forced vibratingsinusoidal signal to an experimental prototype which is composed of both a TLMD and a buildingstructure.

문장표절률: **0%**

Then, the hybrid testing method is performed to evaluate the performance of a TLMD, in which the buildingstructural modelis used as a numerical part, and the TLMD is experimen− tally tested.

문장표절률: **0%**

2.4.1 Developed TLMD Model Figure 2.9 shows the plan view of the TLMD used in this study. The bidi− rectional TLMD would be installed in the POSCO New Songdo City Tower 1A in Incheon, South Korea with 64 stories and 236 meters in height.

문장표절률: **0%**

An eigenvalue analysis of the tower resulted in 0.182 and 0.162Hz in the x, y− directions, respectively, for the first natural frequencies, and 34, 000tons for the first modal mass.

문장표절률: **0%**

The total mass of the bidirectional TLMD is 600tons that results from the effective mass ratio of about 1.76%. The experimental building and TLMD models were manufactured by applying the scaling factors given in Table 2.2 to the first modal proper− ties of the prototype tower.

문장표절률: **0%**

The building model with the parameters shown in Table 2.3 was made by applying the sc√aling factors in Table2.2 to the prototype building.

문장표절률: **0%**

Applying the scale 1/ 20 in frequency to the natural frequencies of a prototype model, 0.182 and 0.162Hz, gives 0.82 and 0.73Hz in the x- and y-directions, respectively.

문장표절률: **0%**

Also, the mass of a buildingstruc- ture is reduced by 4, 250kg. The stiffness of a building modelis calculated to be 4250(kg)x (2pi x 0.82(Hz))2 ~= 110000(N/m) in the x-direction and 4250(kg) x (2pi x 0.73(Hz))2 ~= 89, 000(N/m) in the y-direction, respec- tively.

문장표절률: **0%**

Table 2.2: Similitude law applied to TLMD model Quantity Dimension Length L Mass M Frequency (Hz) T-1 Acceleration LT-2 Scaling factor 1 : 20 1 : 203√= 1 : 8000 1 : 1/ 20 = 1 : 0.223 1 : 1 As shown in Table 2.4, it is obvious that the natural frequencies of a TLMD tune to those of a buildingstructure in the TMD(x) and TLCD(y)- 26 Chapter.

문장표절률: **0%**

2. Hybrid Testing Method : 5-$% $POUSPM 5-.% 5.% Y$POUSPM QBSUJUJPO 3VCCFS QBE 3VCCFS HVJEF #FBSJOH Figure 2.9: Concept of a TLMD control directions, respectively.

문장표절률: **0%**

The masses of a TLMD with the ratios of 1.8 and 0.8% to the mass of a building model become 75kg in the TMD- control and 32kg in the TLCD-control directions, respectively.

문장표절률: **0%**

The stiffness of rubber columns used in a TMD, k, and the liquid length of a TLCD, L, are determined by k = m (2pifm) 2 (2.33) 2g L = (2pifL) 2 (2.34) where m and fm are the mass and the tuned frequency of a TLCD, respectively, in the TMD-control direction.

문장표절률: **0%**

g and fL are the gravity accel- eration and the tuned frequency of the TLCD, respectively, in the TLCD- control direction. With these relations, the final parameters of a TLMD are shown in Table 2.4.

문장표절률: **0%**

27 Chapter. 2. Hybrid Testing Method Table 2.3: Design parameters of the building model Design parameter y-direction x-directionSiffness (N/m) 88, 000 110, 000 Frequency (Hz) 0.73 0.82 Mass (kg) 4, 250 4, 250 Table 2.4: Design parameters of a TLMD model Design parameters TLCD control direction TMD control directionSiffness or liquid length 0.98m (liquid length) 1990N/m (stiffness) Frequency (Hz) 0.73 0.82 Mass (kg) 35 75 28 Chapter.

문장표절률: **0%**

2. Hybrid Testing Method 2.5 Design of Experimental Controller 2.5.1 Experimental System for Substructurubg Technique The experimental system is shown in Figure 2.10 and 2.11 was equipped in Seismic Retrofitting & Remodeling Research Center at the Dankook Univer- sity, Seoul, Korea.

문장표절률: **0%**

The test structure (the experimental substructure) used in this experiment is a two-story steel frame with a single bay. The height and width of the experimental substructure are 1.0 and 0.6 m, respectively.

문장표절률: **0%**

The first floor mass, mE(1), and the second floor mass, mE(2), are 2.04 and 5.10 kg, respectively. The experimental substructure is excited by a uni-axial shaking table.

문장표절률: **0%**

The accelerometers are attached to each floor of the exper- imental substructure to measure its absolute floor acceleration responses.

문장표절률: **0%**

Additionally, an accelerometer is placed on the shaking tableto monitor its motion. The data acquisition and implementation of the digital shaking ta- ble controller are performed using a real-time digital signal processor (DSP).

출처표시 문장 문장표절률: **0%**

The major task of the data acquisition board is to carry out the analog-to- digital (A/D) conversion of the measured acceleration data and the digital- to-analog (D/A) conversion of the reference signal computed by the shaking table controller, which is programmed using LabVIEW (Bishop, 2007).

문장표절률: **0%**

An 8-channel data acquisitionsystem was employed using an NI PCI-6052E board and an NI SC-2345 BNC cable connector as a signal conditioner.

문장표절률: **0%**

Figure 2.10: Overall view of experimental system 29 Chapter. 2. Hybrid Testing Method acceleration transducer esuxbpsetrriumcetunrtael Voltage acceleration signal transducer amplifier D:₩Experiment_dankook₩churn₩0119₩input₩elcacc1.txt 0 .010 0 .300 2 [0..2] 2000 DOF3.vi 0 0 3rd Acc0..00000000000000000 1 00 Itable.vi0..00000 0000000 00000000000000000000.000000000 0 0.000000 000000000 2rd Acc 1 1 1 0 0 0 0.000000000000 - 100..000000000000 1st Acc 0 .0000.

문장표절률: **0%**

0 .0 0 00 0 00 0 00 0 00 00000000000 Controller gain2 0000 000 0.000 0000000000000 interface ofrce (kgf) 3rd Acc. (m/s^2) D:₩Experiment_dankook₩churn₩0119₩mat₩AD3_tusnti_2.txt 2nd Acc.

문장표절률: **0%**

(m/s^2) D:₩Experiment_dankook₩churn₩0119₩data₩el03.dat D:₩Experiment_dankook₩churn₩0119₩mat₩BD3_tustni_2.txt Input motion (m/s^2) I 1st Acc.

문장표절률: **0%**

(m/s^2) S nhpaukt siinggn aTlatbole (V) D:₩Experiment_dankook₩churn₩0119₩mat₩CD3_tustni_2.txt D:₩Experiment_dankook₩churn₩0119₩mat₩DD3_tusnti_2.txt 1st Acc., 4th 2n(Vd) Acc., 5th (V) Table Acc., 3rd (V) arrange_3dof.vi arrange_table.vi D:₩Experiment_dankook₩churn₩0119₩mat₩iAdg1_tustni.txt D:₩Experiment_dankook₩churn₩0119₩mat₩iBdg1_tustni.txt AD D:₩Experiment_dankook₩churn₩0119₩mat₩iCdg1_tustni.txt D:₩Experiment_dankook₩churn₩0119₩mat₩iDdg1_tustni.txt Signal Conditioner DA [NPCI Lfoarb VcoIEnWtro] l DataAPcCqIu-6is0i5ti2oEn Board Controlsignal Shaking TableServo MotorSMeDro r it vo voer Figure 2.11: Schematic diagram of experimental system 2.5.2 Shaking table controller The composition of the experimental system is illustrated in Figure 2.11.

문장표절률: **76%**

The shaking tableshown in Figure 2.11 moves in accordance with the con- trol signal, which is generated by the control computer and sent through D/A conversion board.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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발행 : 서울 : 단국대학교 대학원, 2007.2

2.6. The shaking tableshown in Fig. 2.6 moves in accordance with the con trol signal, which is generated by the control computer and sent through D/A conversion board.

문장표절률: **59%**

In almost every case, the target acceleration signal and actual acceleration produced by the shaking table are different in their amplitudes and phases due to the shaking table dynamics.

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In almost every case, the target acceleration signal and actual acceleration generated by the shaking table are different in their amplitudes and phases due to the shaking table dynamics.

문장표절률: **94%**

Therefore, in order to compensate the distortion of the actual shaking table acceleration against the shaking table dynamics existing between the reference signal and the actual measured acceleration of the shaking table, the inverse transfer function of the actual acceleration of shaking table with respect to the com- mand signal generated by the control computer is constructed and imple- mented in the shaking table control computer as shown in Figure 2.15.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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Therefore, in order to compensate the distortion of the actual shaking table acceleration against the shaking table dynamics existing between the reference signal and the actual measured acceleration of the shaking table, the inverse transfer function of the actual acceleration of shaking table with respect to the com mand signal generated from the control computer is constructed and imple mented in the shaking table control computer as shown in Fig.

문장표절률: **57%**

First, the inverse transfer function, of which amplitude and phase are represented in Figure 2.12 by the dashed line, is obtained experimentally.

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2.8. First, the inverse transfer function, of which amplitude and phase are represented in Fig. 2.7 by the dashed line, is obtained experimentally.

문장표절률: **100%**

Then, the ex- perimental inverse transfer function is approximated by a rational function for its implementation in the control computer.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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Then, the ex perimental inverse transfer function is approximated by a rational function for its implementation in the control computer.

출처표시 문장 문장표절률: **0%**

In this verification exper- iment, the inverse transfer function of the shaking table is approximated using the command invfreqs in MATLAB (Little and Shure, 1992), which adopts the damped Gauss-Newton method for the iterative search to min - imize the sum of the squared error between the measured and the desired frequency response points(Dennis Jr and Schnabel, 1983).

문장표절률: **0%**

The approxima- tion result is given by the following 5-th order linear filter and compared with the experimental one in Figure 2.12.

문장표절률: **0%**

Inverse transfer function, Eq. (2.35), corresponds to the shaking table controller of Figure 2.1. 0.6s5 + 94s4 + 10746s3 + 498200s2 + 167124s+ 108216 G-1(s) = (2.35) s5 + 204s4 + 15900s2 + 8252s2 + 4676s+ 405 30 Chapter.

문장표절률: **0%**

2. Hybrid Testing Method 7 H & " YQQQFSPSJYNJNFOBUUJPO %FH 'SFRVF O DZ)[Figure 2.12: Inverse transfer function of shaking table Control computer Reference signal r(t) ControlSignal Shaking Acceleration of c(t) tabletable, a(t) Transfer function of shaking table, TRF G e (s) = a(t) / r(t) Figure 2.13: Definition of the transfer function of shaking table For the implementation in the digital computer, Eq.

문장표절률: **0%**

(2.35) is realized into the following state equation. ẋc = Acxc + Bcrc yc = Ccxc + Dcrc (2.36) where, xc, rc and yc is thestate vector, the reference signal, the controlsignal of the shaking table controller, respectively.

문장표절률: **0%**

Ac, Bc, Cc and Dc is the 5x 5 state matrix, the 5x 1 reference signal influence matrix, the 1x 5 output matrix and the coupling coefficient between the reference and control signal.

문장표절률: **0%**

In order to verify the performance of the shaking table controller, a down-scaled El Centro earthquake is input to the inverse transfer function of the shaking table.

문장표절률: **0%**

Then, the corresponding acceleration of the shaking table is measured. Figure 2.16 compares the reference acceleration with the 31 Chapter.

문장표절률: **0%**

2. Hybrid Testing Method Control computer Reference signal r(t) Transfer function of Acceration of table, a(t) nal Shaking shaking table, TRF ControlS ig G 1 c(t) e- (s) = r(t) / a(t) table = reference signal, r(t) Figure 2.14: Compensation using the inverse transfer function of shaking table YE(2) mE(2) cE(2), kE(2) YE(1) mE(1) cE(1), kE(1) YE(0) Control computer (LabVIEW) Data acquisition Reference acceleration r(t) Shaking table control Inverse Transfer Functionsignal of Shaking Table G□1(s) Figure 2.15: Flow chart of the experimental system controller corresponding measured acceleration of the shaking table.

문장표절률: **0%**

It is observed that they agree well with each other. 2.5.3 Experimental System for Hybrid Testing of Building with TLD Experimental setup In order to experimentally verify the hybrid testing method, an experimental systemshown in Figure 2.17 was set up in Seismic Retrofitting & Remod- eling Research Center at the Dankook University, Seoul, Korea.

문장표절률: **0%**

The TLD was uniaxially excited by the shaking table on which it was mounted. The shear-type load-cell was inserted between the TLD and the shaking tableto measure the base shear force yielded by the horizontal motion of the TLD during the test.

문장표절률: **0%**

Also, an accelerometer was attached to the shaking tableto monitor its motion. 32

Chapter. 2. Hybrid Testing Method Figure 2.16: Compensation result for the dyna mic characteristic of shaking

문장표절률: **0%**

tableTuned Liquid Damper shear-type load cell accelerometerShaking Table acce leration signal (voltage) transducer amplifier

문장표절률: **0%**

kafl f f WXXf f XU WUWXWW WUZWW Y WUUY YWWW kvmZU Z h W W WUUWWWWWWWWWWWWWWW WWWWWWWW X W WUWWWWWWW WWWW p U WUWWWWWWW WWWW WWUUWWWWWWWWWWWWW W WWWWWWWW Y h X X

문장표절률: **0%**

X W W W WUWWWWWWW WWWW TX WUWWWWWWW WWWW X h WUWWUWWWWWWW WWWW j WUWWWWWWW WWWW WUWWWW WWW WWWW Y WUWWWWWWW WWWW O P Z h UO V YP

문장표절률: **0%**

kaf l f fWXXf fhkZ YU Y h UO V YP p kafl f fWXXf f WZU kafl f fWXXf fikZ Y U p O V YP X h UO V YP z { O}P kafl f fWXXf f jkZ YU kafl f fWXXf f kkZ YU X h US [

문장표절률: **0%**

Y O }Ph US ₩ O}P { h US Z }OP Z U U kaf l f fWXXf f h X U kafl f fWXXf f i X U AD kafl f fWXXf f j X U kafl f fWXXf f k X U Signal Condit DA Cont [SC-234 5]

문장표절률: **0%**

ioner [NI Lraobl VPICEW] D[PACQI- 6B0o5a2rEd] controlsignal (voltage) Servo MotorSMervoDroitvoerr Figure 2.17: Schematic diagram of experimental set-up

문장표절률: **0%**

Integrated Controller of the Numerical Structural Model and the Shaking TableTh e numerical structural model and the shaking table dynamics discussed

문장표절률: **0%**

in the previous subsections are integrated into the controller to implement the hybr id testing method. Figure 2.18 illustrates the block diagram of the hybrid testing method.

문장표절률: **0%**

In the figure, the absolute acceleration is produced by the numerical structural mo del of Eq. (2.21) with two inputs of the measured interacting force, ie(t), and not t he measured but the prescribed earthquake recordsignal, z̈0(t), as marked by the s haded area.

문장표절률: **0%**

Themotion of the shaking table is driven by the controller using the inverse transfe r function to minimize the error between the absolute acceleration, Ÿn(t), calculat ed as the top story response of the structure and the actual shaking table accelerati on, Ÿe(t).

문장표절률: **0%**

Accordingly, the shaking table itself behaves as the top story of the structure, at w hich a TLD is installed, and excites the upper TLD that should be physically teste d.

문장표절률: **0%**

33 Chapter. 2. Hybrid Testing Method Control computer (LabVIEW) interacting f orce, i (te) input ground acceleration &z&0 (t) Tuned Liquid Damper load cell Y&& (te) DSytnraumctiucrse of {z&(t)} = [A]{z(t)}+ [B]{u(t)} c c {O(t)} = [C]{ z(t)}+ [D]{u(t)} c c Y&& (tn) actcoeple flroaotiron (dynam tion) SHAKING TA BLE csoingntraoll c characteristic compensa {x& }= [A]{x }+[B]r(t) s s s s c(t)= [C]{x }+D r(t) s s s Figure 2.18: Block diagram of the integrated controller for the hybrid testing system.

문장표절률: **0%**

2.5.4 Experimental System for Hybrid Testing of Building with TLCD The numeri cal part and the shaking table controller discussed in previous subsections should be integrated into the controller to implement the hybrid testing shown in Figure 2 .8.

문장표절률: **0%**

Figure 2.19 illustrates the block diagram for ex- perimentally implementing the te sting method. In the figure, the absolute acceleration is produced by the numerical part such as Eq.

문장표절률: **0%**

(2.28) with two inputs of the measured interacting force, ie(t), and not the measur ed but the prescribed earthquake recordsignal, z̈0(t), by a user in the control com- puter, as marked by the shaded area.

문장표절률: **0%**

Themotion of shaking table is driven by the controller using the inverse transfer fu nction to minimize the error between the controlled absolute acceleration, Ÿn(t), c alculated as the top story response of structure and the actual shaking table accele ration, Ÿe(t).

문장표절률: **0%**

Accordingly, the shaking table itself behaves as the top story of structure, at which a TLCD is installed, and excites the upper TLCD that should be phys- ically teste d.

문장표절률: **0%**

To verify the hybrid testing method, firstly the conventional TLCD-structure inter action modelshown in Figure 2.20(a) is experimentally implemented.

문장표절률: **0%**

Then, the hybrid test is shown in Figure 2.20(b), which the structural model in Fig ure 2.20(a) is incorporated in the numerical calcula- tion of its identified dampin g and stiffness coefficients and measured mass, is performed for the controlled cas e.

문장표절률: **0%**

Finally, two results from controlled cases are compared for the experimental verifi cation of the hybrid testing method.

문장표절률: **0%**

The only shear-type structural model without the upper TLCD shown in Figure 2. 20(a) has the 0.6m and 1.0m of width and height and 169.7kg of measured floor mass.

문장표절률: **0%**

Two records of El Centro and Kobe earthquake waves 34 Chapter. 2. Hybrid Test ing Method Control computer (LabVIEW) Ifnortecrea, cting i t e ( ) Base input ac celeration StDruycntaumrei cSsy ostfem T &z& {z&(t)} = [A]{z(t)}+ [B]{u(t)}0 (t) c cCuolnuemd nL iDqaumidp er {O(t)} = [C]{z(t)}+ [D]{u(t)}c c Y&& t n ( ) Load cell c Inverse Transfer Functionof Shaking TableSHAKING TABLEsiognntar lol {x& }= [A]{x }+[B]r(t) s s s s c(t)= [C]{x }+D r(t) s s s Figure 2.19: Controll er for implementing the hybrid testing method were excited by the shaking tableto measure the absolute structural acceler- ation.

문장표절률: **0%**

The identification was conducted with measured accelerations of the structure mo del and the shaking table. The identified parameters have slight differences accord ing to input earthquake waves.

문장표절률: **0%**

The averaged damping, and stiffness coefficients were determined by 14.6N ·s/m and 9914.3N/m, respec- tively, which correspond to 1.23Hz of structural natural frequency.

문장표절률: **0%**

The level of water in a TLCD tank was adjusted to sympathize the TLCD frequen cy to this identified structural one. Top Acceleration 35 Chapter.

문장표절률: **0%**

2. Hybrid Testing Method (a) conventional testing method (b) hybrid testing meth od Figure 2.20: Experimental view of a building with a TLCD 36 Chapter.

문장표절률: **0%**

2. Hybrid Testing Method 2.5.5 Experimental System for Hybrid Testing of Build ing with TLMD The difference between the conventional test method and hybrid t esting method is that the upper TLMD is adopted as the experimental part, while t he structural modelis numerically calculated by a computer in the hybrid testing method, as shown in Figure 2.21.

문장표절률: **0%**

The control force acting between their interfaces is measured with a shear-type lo ad cell which is mounted on the shaking table.

문장표절률: **0%**

Then, the measured force is fed-back to the numerical analysis part. Finally, the shaking table vibrates the upper experimental part with the responses calculated from the numerical analysis part.

문장표절률: **0%**

In this case, the shaking table is moved by the controlsignal sent from the control computer through DA channel of DAQ board.

문장표절률: **0%**

The amplitude and phase of the signal values measured at the shaking table, however, are different from the controlsignal sent from the control computer.

문장표절률: **0%**

In this pa- per, the inverse transfer function of a shaking table was designed through the definition of the transfer function of a shaking table, as shown in Fig- ure 2.13.

문장표절률: **0%**

Then, a white-noise excitation test of the shaking table is carried out to compensate the dynamic characteristics between the shaking table and controlsignals, as shown in Figure 2.14.

문장표절률: **0%**

Figure 2.12 shows the inverse transfer function of the shaking table which was measured by the acceleration signal as an input data and the commandsignal as an output data.

문장표절률: **0%**

The measured inverse transfer function of the shaking table could be approximated by using a fifth-order linear filter rep- resented by &YQFSJNFOUBM QBSU @ 5-.% $POUSPM EFWJDF &YQFSJNFOUBM QBSU 4USVDUVSF NPEFM /VNFSJDBM QBSU /VN 3FBM UJ D3BF F MDB S VM J DB M QBSU MPBE DFMM NFBTV NSJOFH M UBJNUJOFH TIBLJOH UBCMF 3MFPBBME UJJONHF Figure 2.21: Conceptual view of the hybrid testing method of building with TLMD Experimental setup The SDOF structuresubjected to both the external and control forces is given by mẍ+ cẋ+ kx = F (t)- i(t) (2.37) where m, c and k are the mass, damping coefficient and stiffness of the 37 Chapter.

문장표절률: **0%**

2. Hybrid Testing MethodSDOF structure, respectively. F (t) and i(t) are the excitation force and TLMD control force measured at the load cell, respectively.

문장표절률: **0%**

Thestate-space equation and the output equation for the absolute ac- celeration of the SDOF structural modelsuch as Eq. (2.37) are represented by ż = Az + Bu (2.38) ȳ1 = Cz + Du (2.39) where z and u arestate variable and input vector, and can be expressed as z = [x, ẋ]〉 and u = [i(t), F (t)]〉, respectively.

문장표절률: **0%**

ȳ1 is the absolute acceleration of the SDOF structural model, and the matrices A, B, C and D are follow- up as Eqs. (2.40)-(2.43), respectively.

문장표절률: **0%**

[ ] 0 1 A = [-k/m -c/m] (2.40) 0 0 B = [- (2.41)1/m 1/m C = [-]]k/m -c/m (2.42) D = -1/m 1/m (2.43) Finally, the controller both considering the numerical part of the SDOF structural model and the inverse transfer function of a shaking table is con- structed to implement the hybrid testing method as shown in Figure 2.22.

문장표절률: **0%**

Figure 2.23 shows the experimental configuration of the test. The hybrid testing method is fatal to the noise and phase error because the shaking table is vibrated by the numerical part which is calculated in real-time.

문장표절률: **0%**

Accordingly, the hybrid test using the Real-Time Window Target of the MATLAB Simulink with the sampling rate of 1000 Hz wasimplemented to minimize the calculation and phase error in the actual test.

문장표절률: **0%**

Figure 2.24 is an excitation model of the Real-Time Window Target of the MATLAB Simulink, and it includes the inverse transfer function of the shaking table an d numerical analysis of the SDOF structure.

인용포함 문장 문장표절률: **0%**

38 Chapter. 2. Hybrid Testing Method NUMERICAL PART Control Computer (MATLAB) EPAXPRETRIMENTAL MEASURING inte Tuned Liquid Column Ma ss Damper acting force, ie (t) Load , F { Dynamics of Structure w(t) {z(t)}}= [Ac]{ z(t)} + [Bc]{ u( )t}O (t) = [Cc]{ z(t)} + [Dc]{ u(t)} CALCULATING load c ell ast (t) I AccelerationSnhvaekrisneg tTraabnlsefer function of shaking table {x } =LOADING [ ] + Control signal (s A) = [sC]{ x{ s} Bx } [s] r tc t s s + D s r((t)) Figure 2.22: Design of the controller for the hybrid testing method Figure 2.23 : Photograph of the hybrid testing OUFSBDUJPO GPSDF / "*OOBQMVPUH *O 0VU 6 & J 4VC %/"

인용포함 문장 문장표절률: **0%**

B2U " $JP O BO B SEB MPM * HO T * U OQVU S&V N⟨BFVOUPUT⟩ 5P 8PSL TQBDF YZ O O $ Y" YO O % #VV O O Y ZO O

인용포함 문장 문장표절률: **0%**

$"Y YO O %#VV O O 4%0' 4USVDUVSF 4F 6MF &DU PS JOWFSTF TIBLJOH UBCMF JOQ NBU 'SPN 'JMF (BJOJOQVU MPBE / %/"B " 2U O $JP B BO M SE B PMH * O0 T U V S U &V Q N V ⟨BF U VOUPUT⟩ Figure 2.24: Design contro ller of the hybrid testing method (MATLAB Simulink Real-time Window Target) 39 Chapter.

문장표절률: **0%**

2. Hybrid Testing Method 2.6 Experimental Verification 2.6.1 Experimental resul t of Substructuring technique The validity of the proposed substructuring technique as part of the hy- brid testing method is verified for the experimental setting descr ibed in the previous sections.

문장표절률: **60%**

First, the shaking tabletest without feedback loop of ac- celerations measured fro m the experimental substructure into the shaking table controller in Figure 2.6 is p erformed to confirm the validity of the proposed method experimentally.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계
저자 : 박은천
발행 : 서울: 檀國大學校, 2006

First, the shaking tabletest without feedback loop of ac celerations measured from the experimental substructure into the shaking table controller in Fig.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures
저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

First, the shaking tabletest without feedback loop of ac celerations measured from the experimental substructure into the shaking tabic controller in Fig.

문장표절률: **100%**

In this case, the thirdstory acceleration of responses pre-calculated from the assu med whole building with structural parameters such as Eqs.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계
저자 : 박은천
발행 : 서울: 檀國大學校, 2006

2.11 is performed to experimentally confirm the validity of the proposed method. In this case, the thirdstory acceleration of responses pre-calculated from the assum ed whole building with structural parameters such as Eqs.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures
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발행 : 서울 : 단국대학교 대학원, 2007.2

2.11 is performed to experimentally confirm the validity of the proposed method. In this case, the thirdstory acceleration of responses pre-calculated from the assum ed whole building with structural parameters such as Eqs.

문장표절률: **59%**

(2.16) and (2.17) is used as a reference signal in Figure 2.15. Figure 2.25 compar es the time histories and Fourier transform of the acceleration responses, which ar e measured from the experimental substructure and shaking table, with those calc ulated from the numerical analysis of the whole assumed structure.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures
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(2.18) and (2.19) is used as a reference signal in Fig. 2.8. Fig. 2.12 compares the t ime histories and Fourier transform of the acceleration responses, which are meas ured from the experimental substructure and shaking table, with those calculated f rom the numerical analysis of the assumed whole structure.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계
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(2.18) and (2.19) is used as a reference signal in Fig. 2.8. Fig. 2.12 compares the t ime histories and Fourier transform of the acceleration responses, which are meas ured from the e행eiimental substructure and shaking table, with those calculated from the numerical analysis of the assumed whole structure.

문장표절률: **62%**

In other words, the responses cor- responding to the 3rd, 4th and 5th story accelerations are compared. Also, Figures 2.26-2.28 showing the variation of frequency components according to time lapse illustrate the spectrogram and contour plots of experimental and numerical accelerations of the 3rd, 4th and 5th story, respectively.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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In other words, the responses con^esponding to the 3rd, 4th and 5th story accelerations are compared. Also, Figs. 2.13~2.15 showing the variation of frequency components according to time lapse illustrate the spectrogram and 24 2.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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In other words, the responses cor responding to the 3rd, 4th and 5th story accelerations are compared. Also, Figs. 2.13~2.15 showing the variation of frequency components according to time lapse illustrate the spectrogram and 24 2.

문장표절률: **55%**

As can be confirmed from Figure 2.25, the experimental accelerations obtained from the shaking tabletest without their feedback agree well with those obtained from the analysis of the whole assumed structure in both time and frequency domains.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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As can be coiifimied from Fig. 2.12, the experimental accelerations obtained from the shaking tabletest without their feedback agree well with those obtained from the analysis of the assumed whole structure in both time and frequency domains.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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As can be confirmed from Fig. 2.12, the experimental accelerations obtained from the shaking tabletest without their feedback agree well with those obtained from the analysis of the assumed whole structure in both time and frequency domains.

문장표절률: **46%**

However, it can be observed that the small discrepancies are shown in the time histories of 4th and 5th story accelerations as shown from Figure 2.25, while the 3rd story acceleration is identical to the numer- ical one over the entire time history as known from Figures 2.25-2.26.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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However, it can be observed that the small discrepancies are shown in the time histories of 4th and 5th story accelerations as shown from Fig.

문장표절률: **63%**

These differences are caused by the inherent modes of experimental substructure; the frequency components of 2.5 and 8.6 Hz corresponding to the firstandsecond modes of the experimental substructure, respectively, are observed in the measured acceleration of 4th story as known from Figure 2.27, and also the component of 2.5 Hz is expressed in the 5th story experimental accel- eration as like Figure 2.28.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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These differences are caused by the inherent modes of experimental substructure; the frequency components of 2 5 and 8.6 Hz corresponding to the firstandsecond modes of the experimental substructure, respectively, are observed in the measured acceleration of 4th story as known from Fig.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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These differences are caused by the inherent modes of e^erimental substructure; the frequency components of 2.5 and 8.6 Hz corresponding to the firstandsecond modes of the experimental substructure, respectively, are observed in the measured acceleration of 4th story as known fiom Fig.

문장표절률: **54%**

It is considered that this tendency is especially conspicuous in the case of utilizing a lightly-damped testing model as an ex- perimental substructure.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

2.14, and also the component of 2.5 Hz is expressed in the 5th story ex perimental acceleration as like Fig. 2.15. It is considered that this tendency is especially conspicuous in case of utilizing a lightly-damped testing model as an ex perimental substructure.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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2.14, and also the component of 2.5 Hz is expressed in the 5th story ex perimental acceleration as like Fig. 2.15. It is considered that this tendency is especially conspicuous in case of utilizing a lightly-damped testing model as an ex perimental substructure.

문장표절률: **83%**

Table 1 shows the frequency components observed in the time records of an experimental substructure from the test without its acceleration feedback and the natural frequencies calculated from the whole assumed structure with five stories.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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Table 1 shows the frequency components observed in the time records of an experimental substructure from the test without its acceleration feedback and the natural frequencies calculated from the assumed whole structure with five stories.

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저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Table 1 shows the frequency components observed in the time records of an experimental substructure from the lest without its acceleration feedback and the natural frequencies calculated from the assumed whole structure with five stories.

문장표절률: **100%**

From Table 2.1, it can be noted that the first natural frequency of the experimental substructure is shifted from 2.5 Hz to 1.3 Hz by the dynamics of the three-story numerical substructure added to its base.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

From Table 2.1, it can be noted that the first natural frequency of the experimental substructure is shifted from 2.5 Hz to 1.3 Hz by the dynamics of the three-story numerical substructure added to its base.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

From Table 2.1, it can be noted that the first natural frequency of the experimental substructure is shifted from 2.5 Hz to 1.3 Hz by the dynamics of the three-story numerical substructure added to its base.

문장표절률: **59%**

Then, the substructuring testing expressed as Figure 2.6 was carried out based on the acceleration feedback of the experimental sub- structure.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Then, the real-time substructuring shaking tabletest expressed as Fig. 2.11 was carried out based on the acceleration feedback of the experimental sub structure.

문장표절률: **0%**

Figure 2.29 compares the responses measured by the test with the acceleration feedback of the experimental substructure with those cal- 40 Chapter.

문장표절률: **30%**

2. Hybrid Testing Method culated from the numerical analysis of the whole assumed structure with 5 DOFs. Also, Figures 2.30-2.32 express the frequency components according to time lapse, which is observed in the measured responses from the test with feedback and the calculated ones of the 3rd, fourth and fifth story, re- spectively.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Fig. 16 compares the responses measured from the test with the acceleration feedback of the experimental substructure with those calculated from the numerical analysis of the assumed whole structure with 5 DOFs Also, Figs, 2.17~2.19 express the frequency components according to time lapse, which are observed in the measured responses from the test with feedback and the calculated ones of the 3rd,4th and 5th story, re spectively.

문장표절률: **59%**

As known from Figure 2.29, the inclination in entire time history responses measured from the proposed testing method agrees well with that calculated from the whole assumed structure.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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As known from Fig. 2.16, the inclination in entire time history responses measured from the proposed testing method agrees well with that 25 2.

문장표절률: **44%**

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시

These are why the first mode responses of substructured system coincide well with those of the whole supposed system over the entire time range, as shown in Figure s 2.30-2.32.

스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

REAL-TIME SUBSTRUCTURING TECHNIQUE calculated from the assumed wh ole structure. This is why the first mode responses of substructured system coincide well with those of the assumed whole system over the entire time range, as shown in Figs.

문장표절률: **53%**

However, as can be confirmed from Figures 2.30-2.32, instead of the second and third mode responses of the substructured system, those of the experi- mental subs tructure are observed from the testing results in the vicinity of 2.5 and 8.6 Hz.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

2.17-2.19. However, as can be confirmed from Figs. 2.17-2.19, instead of the 2n d and 3rd mode responses of substructured system, those of the experi mental subst ructure are observed from the testing results in the vicinity of 2.5 and 8.6 Hz.

문장표절률: **74%**

It is considered that in the process of the acceleration feed- back of the experiment al substructure, its fundamental modes affect to the numerical substructure and the n the numerical error occurs in calculating the numerical substructure.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

It is considered that in the process of the acceleration feed back of the experimenta l substructure, its fundamental modes affect to the numerical substructure and then numerical error occurs in calculating the numerical substructure.

인용포함 문장 문장표절률: **38%**

41 Chapter. 2. Hybrid Testing Method &"YOQBFMZSTJNJTFOU 5JNF TFD (a) Time domain N T UI PPS &"YOQBFMZSTJNJTFOU 'SFRVF ODZ)[(b) Frequen cy domain Figure 2.25: Comparisons of results measured from the experiment wit hout feedback and those calculated from numerical analysis.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

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Comparisons of results measured from the experiment without FEEDBACK AND THOSE CALCULATED FROM NUMERICAL ANALYSIS ....27 Figure 2-13.

문장표절률: **0%**

SE PPS UI PPS 42 (a) Spectrogram of the response measured from the experiment without feedback 'SF RVFODZ)[(c) Contour plot of the response measured from the experiment without feedback 5JNF TFD Chapter.

문장표절률: **0%**

2. Hybrid Testing Method (b) Spectrogram of the response calcu- lated from the numerical analysis mea- sured 'SF RVFODZ)[(d) Contour plot of the response c alcu- lated from the numerical analysis mea- sured 5JNF TFD Figure 2.26: Spect rograms and contour plots of the 3rd story acceleration measured from the experi ment without feedback and that calculated from the numerical analysis.

문장표절률: **0%**

43 Chapter. 2. Hybrid Testing Method (a) Spectrogram of the response measured from the experiment without feedback 'SF RVFODZ)[(c) Contour plot of the resp onse measured from the experiment without feedback 5JNF TFD (b) Spectrogram of the response calcu- lated from the numerical analysis mea- sured 'SF RVFODZ)[(d) Contour plot of the response calcu- lated from the numerical analysis mea- sured 5JNF TFD Figure 2.27: Spectrograms and contour plots of the 4th story acc eleration measured from the experiment without feedback and that calculated fro m the numerical analysis.

문장표절률: **0%**

44 (a) Spectrogram of the response measured from the experiment without feedbac k 'SF RVFODZ)[(c) Contour plot of the response measured from the experiment without feedback 5JNF TFD Chapter.

문장표절률: **0%**

2. Hybrid Testing Method (b) Spectrogram of the response calcu- lated from the numerical analysis mea- sured 'SF RVFODZ)[(d) Contour plot of the response c alcu- lated from the numerical analysis mea- sured 5JNF TFD Figure 2.28: Spect rograms and contour plots of the 5th story acceleration measured from the experi ment without feedback and that calculated from the numerical analysis.

인용포함 문장 문장표절률: **0%**

45 Chapter. 2. Hybrid Testing Method N T "OBMZTJT 5JNF TFD (a) Time dom ain N T &"YOQBFMZSTJNJTFOU 'SFRVF ODZ)[(b) Frequency domain Figure 2.29: Comparisons between results from the experiment with feedback and those f rom analysis.

문장표절률: **0%**

SE PPS UI PPS 46 (a) Spectrogram of the response measured from the experiment without feedback 'S FRVFODZ)[(c) Contour plot of the response measured from the experiment without feedback 5JNF TFD Chapter.

문장표절률: **0%**

2. Hybrid Testing Method (b) Spectrogram of the response calcu- lated from the numerical analysis mea- sured 'S FRVFOD Z)[(d) Contour plot of the response c alcu- lated from the numerical analysis mea- sured 5JNF TFD Figure 2.30: Spect rograms and contour plots of the 3rd story acceleration measured from the experi ment with feedback and that calculated from the numerical analysis.

문장표절률: **0%**

47 Chapter. 2. Hybrid Testing Method (a) Spectrogram of the response measured from the experiment without feedback 'SF RVFODZ)[(c) Contour plot of the resp onse measured from the experiment without feedback 5JNF TFD (b) Spectrogram of the response calcu- lated from the numerical analysis mea- sured 'SF RVFODZ)[(d) Contour plot of the response calcu- lated from the numerical analysis mea- sured 5JNF TFD Figure 2.31: Spectrograms and contour plots of the 4th story acc eleration measured from the experiment with feedback and that calculated from th e numerical analysis.

문장표절률: **0%**

48 (a) Spectrogram of the response measured from the experiment without feedbac k 'SF RVFODZ)[(c) Contour plot of the response measured from the experiment without feedback 5JNF TFD Chapter.

문장표절률: **0%**

2. Hybrid Testing Method (b) Spectrogram of the response calcu- lated from the numerical analysis mea- sured 'SF RVFODZ)[(d) Contour plot of the response c alcu- lated from the numerical analysis mea- sured 5JNF TFD Figure 2.32: Spect rograms and contour plots of the 5th story acceleration measured from the experi ment with feedback and that calculated from the numerical analysis.

문장표절률: **0%**

49 Chapter. 2. Hybrid Testing Method 2.6.2 Hybrid Testing Method of a Single S tory Strcuture with a TLD In this section, experimental verification of the hybrid t esting method is conducted for a single story steel frame with a TLD.

문장표절률: **0%**

First, the conventional TLD-structure interaction modelshown in Figure 2.33(a) is tested. Then, the hybrid testing methodshown in Figure 2.33(b), which incorporate s the single story steel frame in the numerical calculation, is performed and the res ults from the two testing methods are compared to each other.

문장표절률: **0%**

For the numerical structural model used in the hybrid testing method, the single st ory steel frame is assumed to be an SDOF mass-damping-springsystem.

문장표절률: **0%**

The structure has 0.6m of width, 1.0m of height and 169.7kg of measured floor m ass. El Centro, Hachinohe, Mexico City, and Northridge earthquake waves were r ealized by the shaking table, and the resulting absolute ac- celerations of the floor and the shaking table were measured.

문장표절률: **0%**

The system identification was conducted using the measured absolute acceleration s. The identified parameters slightly vary according to input earthquake waves.

문장표절률: **0%**

The averaged damping and stiffness coefficients are 14.6N ·s/m and 9914.3N/m, respectively, which correspond to 1.23Hz of structural natural frequency.

출처표시 문장 문장표절률: **0%**

The TLD shown in Figure 2.33 has the size of 31(cm) x 14(cm) x 20(cm). The lev el of water in the TLD was adjusted to have 3.4cm that is theoreti- cally calculat ed based on the linear wave theory(Soong and Dargush, 1997) for the TLD to hav e fundamentalsloshing frequency tuned to the identified structural natural frequenc y.

문장표절률: **89%**

As a result, the mass ratio of the TLD to the structure is about 1.3%. To confirm whether the numerically calculated fre- quency of the TLD is modulated to the str uctural one, the transfer function is shown in Figure 2.34, from the shaking table a cceleration to the shear force by the TLD, was obtained by using the white noise e xcitation.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

As a result, the mass ratio of the TLD to the structure is about 1.3 To confirm whether the numerically calculated fre quency of the TLD is modulated to the structural one, the transfer fimction shown in Fig.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures
저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

3.5, from the shaking table acceleration to the shear force by the TLD, was obtained by using the white noise excitation. It is observed in Fig.

문장표절률: **75%**

It is observed in Figure 2.34 that the TLD has the sloshing frequency of 1.25Hz which is very closeto the structural natural frequency of 1.23Hz.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계
저자 : 박은천
발행 : 서울: 檀國大學校, 2006

3.5 that the TLD has the sloshing frequency of 1.25Hz which is very closeto the structural natural frequency of 1.23Hz. 43 4. RHSTTM for the Performance Evaluation of a Timed Liquid Column Damper 병자 · · 4 m r (a) Conventional shaking tabletest (b) Real-time hybrid shaking tabletest Figure 3-4.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures
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3.5 that the TLD has the sloshing frequency of 1.25Hz which is very closeto the structural natural frequency of 1.23Hz. 43 4. RHSTTM for the Performance Evaluation of a Tuned Liquid Column Damper (a) Conventional shaking tabletest (b) Real-time hybrid shaking tabletest Figure 3-4.

문장표절률: **52%**

At first, the conventional shaking tabletest is shown in Figure 2.33(a) is performed to investigate the seismic response control performance of the TLD.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계
저자 : 박은천
발행 : 서울: 檀國大學校, 2006

3.4 (a) is performed to investigate the seismic response control performance of the TLD. Previously mentioned four earthquake records are scaled to have the peak acceleration of 100 gal and used to excite the TLD-structuresystem.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures
저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

3.4 (a) is performed to investigate the seismic response control performance of the TLD- Previously mentioned four earthquake records are scaled to have the peak acceleration of 100 gal and used to excite the TLD-structuresystem.

문장표절률: **64%**

Previously mentioned four earthquake records are scaled to have the peak acceleration of 100 gals and used to excite the TLD-structuresystem.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계
저자 : 박은천
발행 : 서울: 檀國大學校, 2006

3.4 (a) is performed to investigate the seismic response control performance of the TLD. Previously mentioned four earthquake records are scaled to have the peak acceleration of 100 gal and used to excite the TLD-structuresystem.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures
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3.4 (a) is performed to investigate the seismic response control performance of the TLD- Previously mentioned four earthquake records are scaled to have the peak acceleration of 100 gal and used to excite the TLD-structuresystem.

문장표절률: **68%**

Figures 2.35 and 2.36 show the measured structural acceleration responses in the time and frequency domains, respectively.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계
저자 : 박은천
발행 : 서울: 檀國大學校, 2006

Figs. 3.6 and 3.7 show the measured structural acceleration responses in the time and frequency domains, respectively. It is observed from Fig.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures
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발행 : 서울 : 단국대학교 대학원, 2007.2

Figs. 3.6 and 3/7 show the measured structural acceleration responses in the time and frequency domains, respectively. It is observed from Fig.

문장표절률: **0%**

It is observed from Fig- ure 2.35 that acceleration in the latter part of the whole r esponse history is significantly reduced.

문장표절률: **0%**

This phenomenon is a common tendency in the structural response controlled by a tuned mass-type control devicesince it makes an effect when the structural respons e is governed by the fundamen- tal mode after initial high impulse like componen t has passed.

문장표절률: **0%**

In response to Mexico-city earthquake excitation, as shown in Figure 2.36(c), the first peak corresponding to the major frequency component of the earthquake it- s elf is not controlled, but the response in the region of the TLD modulation 50 Cha pter.

문장표절률: **0%**

2. Hybrid Testing Method (a) Conventional shaking tabletest (b) Hybrid shaking tabletest Figure 2.33: TLD-structure interaction experimental system.

문장표절률: **0%**

frequency is reduced to nearly zero. Then, the hybrid testing method is applied wit h the experimental set-up shown in Figure 2.33(b).

문장표절률: **0%**

For its implementation for the controlled case, the identified structural parameters are reflected in the numerical part expressed by the shaded region in the integrate d controllershown in Figure 2.18.

문장표절률: **0%**

The 51 Chapter. 2. Hybrid Testing Method / N T %FH 'SFRV F ODZ)[1IBTF " NQMJUVEF Figure 2.34: TLD transfer function from the table acceleration to the base shear force continuous filters are converted into discrete ones with a time inte rval of 0.01 second.

문장표절률: **0%**

Figures 2.37 and 2.38 compare the controlled accelerations ob- tained by perform ing the conventional and the hybrid testing method in time and frequency domains , respectively.

문장표절률: **0%**

The effectiveness of the hybrid testing method is verified by the fact that the experi mental results from two methods coincide well with each other on the whole.

문장표절률: **0%**

The small discrepancies existing in the controlled responses subjected to El Centro and Hachinohe earthquakes are considered to result from the underestimation of d amping coefficients in the numerical structural modelsince averaged parameters fo r the four earthquake data were used.

문장표절률: **0%**

52 BDD H Chapter. 2. Hybrid Testing Method UJNF T FD (a) El Centro earthqu ake BDD H UJNF T FD (b) Hachinohe earthquake BDD H UJNF T F D (c) Mexi co city earthquake BDD H UJNF T F D (d) Northridge earthquake Figure 2.35: St ructural acceleration in the time domain measured from the conventional shaking tabletest of TLD-structure interaction system (dotted line : without control, solid l ine : with control) 53 Chapter.

문장표절률: **0%**

2. Hybrid Testing Method H TFD ' SFRVFO D Z)[(a) El Centro earthquake H T FD ' SFRVFO D Z)[(c) Mexico city earthquake H TFD ' SFRVFO D Z)[(b) Ha chinohe earthquake H TFD ' SFRVFO D Z)[(d) Northridge earthquake Figure 2. 36: Structural acceleration in the frequency domain measured from the convention al shaking tabletest of TLD-structure interaction system (dotted line : without con trol, solid line : with control) 54 BDD H Chapter.

문장표절률: **0%**

2. Hybrid Testing Method UJNF TFD (a) El Centro earthquake BDD H UJNF T F D (b) Hachinohe earthquake BDD H UJNF TF D (c) Mexico city earthquake BD D H UJNF T F D (d) Northridge earthquake Figure 2.37: Comparisons of controll ed structural accelerations in the time domain (dotted line : conventional shaking tabletest, solid line : hybrid shaking tabletest) 55 Chapter.

문장표절률: **0%**

2. Hybrid Testing Method H TFD ' SFRVFO D Z)[(a) El Centro earthquake g*s ec120 100 80 60 40 20 0 0 0.5 1 1.5 2 2.5 3 Frequency (Hz) (c) Mexico city earth quake H TFD ' SFRVFO D Z)[(b) Hachinohe earthquake H TFD ' SFRVFO D Z)[(d) Northridge earthquake Figure 2.38: Comparisons of controlled structural ac

celerations in the fre- quency domain (dotted line : conventional shaking tabletest , solid line : hybrid shaking tabletest) 56 Chapter.

문장표절률: **62%**

2. Hybrid Testing Method 2.6.3 Hybrid Testing Method of Three Story Structure with a TLD The control performance of a TLD installed in a three-story structure is investigated by using the hybrid testing method.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

RHSTTM for the Performance Evaluation of a Timed Liquid Column Damper 3.4.2 A Three Story Structure with a TLD The control performance of a TLD installed in a three story structure is investigated by using the RHSTTM.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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RHSTTM for the Performance Evaluation of a Tuned Liquid Column Damper 3.4.2 A Three Story Structure with a TLD The control performance of a TLD installed in a three story structure is investigated by using the RHSTTM.

문장표절률: **54%**

The structure is assumed to be a three story shear-type model, which has identical story properties as follows; mi = 128.8kg, ci = 13.52N ·s/m, ki = 33908N/m for i = 1, 2, 3.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

The structure is assumed to be a three story shear-type model, which has identical story properties as follows; W/= 128.8kg, c, = 13.52N s/m? 33908N/m for z=l, 2, 3.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

The structure is assumed to be a three story shear-type model, which has identical story properties as follows; m/= 128.8kg, c;= 13.52N s/m, 오/= 33908N/m for 1, 2, 3.

문장표절률: **76%**

The structure has natural frequencies of 1.15Hz, 3.22Hz and 4.65Hz. The TLD discussed in the previous section is used, and its water level is modulated to 4.6cm for the TLD to have sloshing frequency of 1.15Hz.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

The structure has natural frequencies of L15Hz, 3 22Hz and 4.65Hz. The TLD discussed in the previous section is used and its water level is modulated to 4.6cm in order for the TLD to have sloshing frequency of 1.15Hz.

문장표절률: **100%**

As a result, the mass ratio of the TLD to the structure is about 2%. The four earthquake waves used for the excitation of the single story steel frame were scaled to have peak acceleration of 40gal.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

As a result, the mass ratio of the TLD to the structure is about 2 The four earthquake waves used for the excitation of the single story steel frame were scaled to have peak acceleration of 40gal.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

As a result, the mass ratio of the TLD to the structure is about 2 The four earthquake waves used for the excitation of the single story steel frame were scaled to have peak acceleration of 40gal.

문장표절률: **100%**

The uncontrolled structural responses were obtained by removing the feedback loop of the TLD-generated interacting force, which causes the numerical structural model to be excited only by the base earthquake motion.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

The uncontrolled structural responses were obtained by removing the feedback loop of the TLD-generated interacting force, which causes the numerical structural model to be excited only by the base earthquake motion.

문장표절률: **72%**

Figures 2.39 and 2.40 compare the uncontrolled and controlled accelerations of the thirdstory in time and frequency domains, respectively, which is realized by the shaking tablethrough the hybrid testing method.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: **檀國大學校**, 2006

Figs. 3.10 and 3.11 compare the uncontrolled and controlled accelerations of the thirdstory in time and frequency domains, respectively, which is realized by the shaking tablethrough the RHSTTM.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Figs. 3.10 and 3.11 compare the uncontrolled and controlled accelerations of the thirdstory in time and frequency domains, respectively, which is realized by the shaking tablethrough the RHSTTM.

문장표절률: **100%**

It is observed that the structural accelerations aresignificantly reduced by the TLD, especially in the region of the fundamental frequency.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: **檀國大學校**, 2006

It is observed that the structural accelerations aresignificantly reduced by the TLD, especially in the region of the fundamental frequency.

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저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

It is observed that the structural accelerations aresignificantly reduced by the TLD, especially in the region of the fundamental frequency.

문장표절률: **0%**

Table 2.5 indicates that the acceleration is reduced by 4 – 30% in peak and by 18 – 60% in RMS responses. It is also identified in Figure 2.40(d) that the TLD lessens the additional second mode response of the structure.

출처표시 문장 문장표절률: **0%**

Figure 2.41 shows the typical sloshing and slamming behaviors of the water in the TLD tanks during the experiment, which occur in the small and large amplitude of the water motion, respectively(Yalla, 2001).

문장표절률: **0%**

Table 2.5: Uncontrolled and controlled responses of a combined TLD-MDOF stucturesystem Responses(g) El Centro Hachinohe Mexico Northridge City Peak acceleration Uncontrolled 3.85 2.71 2.63 1.34 Controlled 2.69 2.19 252 1.34 RMS acceleration Uncontrolled 1.91 1.36 0.54 0.33 Controlled 0.74 0.66 0.45 0.27 57 Chapter.

문장표절률: **0%**

2. Hybrid Testing Method BDD H UJNF T FD (a) El Centro earthquake BDD H UJNF T FD (b) Hachinohe earthquake BDD H UJNF T FD (c) Mexico city earthquake BDD H UJNF T FD (d) Northridge earthquake Figure 2.39: Absolute accelerations in the time domain, measured from the top story of MDOF structure with a TLD by the hybrid testing method (dotted line : without control, solid line : with control)) 2.6.4 Hybrid Testing Method of a Single Story Structure with a TLCD At first, the conventional shaking tabletest with this TLCD shown in Fig- ure 2.20(a) is performed to reduce the structural response.

문장표절률: **0%**

Two earthquake records with themaximum acceleration of 100gal due to the shaking table 58 H TFD ' S FRV FOD Z)[(a) El Centro earthquake H TFD ' SF RVF ODZ)[(c) Mexico city earthquake Chapter.

문장표절률: **0%**

2. Hybrid Testing Method H TFD ' S FRV FOD Z)[(b) Hachinohe earthquake H TFD ' SFR VFO DZ)[(d) Northridge earthquake Figure 2.40: Absolute accelerations in the frequency domain, measured from the top story of MDOF structure wit

h a TLD by the hybrid testing method (dotted line : without control, solid line : with control) (a) Sloshing of TLD (b) Slamming of TLD Figure 2.41: Behaviors of a TLD under the earthquake motion performance are used to excite the TLCD-structuresystem with control case.

문장표절률: **0%**

Then, the hybrid shaking tabletest is conducted with the experimental set- up shown in Figure 2.20(b). For its experimental implementation, the iden- 59 Chapter.

문장표절률: **69%**

2. Hybrid Testing Method tified structural parameters are reflected in the numerical part expressed by the shaded region in the integrated controllershown in Figure 2.19.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

3.4 (b). For its implementation for the controlled case, the identified structural parameters are reflected in the numerical part expressed by the shaded region in the integrated controllershown in Fig.

문장표절률: **78%**

The con- tinuous filters in the figure are converted into discrete ones with a time step of 0.01 sec in the actual implementation of the experiment.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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발행 : 서울 : 단국대학교 대학원, 2007.2

RHSTTM for the Performance Evaluation of a Tuned Liquid Column Damper in Fig. 4.3. The con tinuous filters in the figure are converted into discrete ones with a time step of 0.01 sec in actual implementation of the experiment.

문장표절률: **50%**

Figure 2.42 com- pare the controlled accelerations experimentally measured by implementing the conventional and the hybrid testing method in both time and frequency domain, respectively.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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발행 : 서울 : 단국대학교 대학원, 2007.2

Fig. 4.5 com pare the controlled accelerations experimentally measured by implementing the conventional and the real-time hybrid shaking tabletests in both time and frequency domain, respectively.

문장표절률: **77%**

The validity of the hybrid testing method performed in this paper is verified from the fact that the experimental results from two methods well coincide with each other on the whole.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

The validity of the real-time hybrid shaking tabletest performed in this paper is verified from the fact that the experimental results from two methods well coincide with each other on the whole.

문장표절률: **20%**

BDD H UJNF T FD (a) El Centro Earthquake(time domain) BDD H UJNF T FD (c) Kobe Earthquake(time domain) H TFD ' SFR VFO D Z) [(b) El Centro Earthquake(frequency do- main) H TFD ' SFR VFO D Z) [(d) Kobe Earthquake(frequency domain) Figure 2.42: Comparisons between the results from the conventional testing method(dotted line) and those from the hybrid testing method(solid line) for the controlled response 60 Chapter.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Comparisons between the results from the conventional testing method(dotted line) and those from the RHSTTM(solid line) for the controlled response 61 4.

문장표절률: **0%**

2. Hybrid Testing Method 2.6.5 Conventional Experiment of a Building Controlled by TLMD Experimental installation The test on a scaled-down TLMD building modelshown in Figure 2.44 was performed to experimentally verify the control performance of a proposed TLMD.

문장표절률: **0%**

In order to experimentally describe the dynamic behavior of a building model, the moving mass of 4250kg was mounted on guide rails.

문장표절률: **0%**

Also, the springs that connect the moving mass to both the actuator and the retaining block were devised to characterize the behavior of the stiffness of a building model, as shown in Figure 2.45.

문장표절률: **0%**

In the figure, ms, cs and k1 + k2 = ks represent the mass, damping coefficient and stiffness of a building model, respectively. x1, x2 and x3 denote the displacement and acceleration of a building model, dynamic actuator, and TLMD, respectively.

문장표절률: **0%**

Ten springs with the stiffness of 11, 000N/m for each one were used for the case of a test in the TMD control direction, and eight springs with 8800N/m for each on e for the case of a test in the TLCD control direction.

문장표절률: **0%**

Figure 2.43: Photograph of the manufactured TLMD It is noted from Figure 2.46 t hat the mass of a building modelis ex- cited by force transmitted by the spring, k2 , through the displacement of an actuator, x2.

문장표절률: **0%**

Accordingly, themotion of a building modelis expressed by msẍ1 + csẋ1 + k1x1 − k2 (x2 − x1) = 0 (2.44) In this case, the displacement of an actuator, x2, is given by x2 = Asin (2pifet) (2.45) 61 Chapter.

문장표절률: **0%**

2. Hybrid Testing Method Figure 2.44: Experimental TLMD-building model Fig ure 2.45: Conceptual view of experimental set-up where A and fe are the excitati on amplitude and frequency of an actu- ator, respectively.

문장표절률: **0%**

Finally, the equation of motion of a building modelis obtained by sub- stituting E q. (2.45) into Eq. (2.44). msẍ1 + csẋ1 + ksx1 = k2Asin (2pifet) (2.46) x 1 c x s 1 k x □x 2 2 1 ms x 1 k x 1 1 (a) Mass x 2 k x □ x 2 2 1 F s (b) Actuator Figure 2. 46: Free-body diagram of a building model.

문장표절률: **0%**

62 Chapter. 2. Hybrid Testing Method 2.6.6 Experimental results In this test, the building model was excited by a dynamic actuator installed on the strong wall.

문장표절률: **0%**

Maximum excitation displacement of the dynamic actu- ator was set to be 4 mm. Harmonic waves with the frequency interval of 0.05 Hz from 0.1 to 3.0 Hz were i mposed on the moving mass of a building model by the actuator.

문장표절률: **0%**

Especially, harmonic waves with the frequency interval of 0.01 Hz were excited t o the moving mass in the vicinity of its natural fre- quencies during 200s.

문장표절률: **0%**

Then, the steady-state response of the moving mass was obtained in each excitati on frequency. First, the test was performed in the TMD control direction.

문장표절률: **0%**

In this case, the frequency of structural model was set to 0.82 Hz by connecting sp rings with the stiffness of 110,000 N/m to the structural model with themass of 4, 250 kg.

문장표절률: **0%**

Figures 2.47 and 2.48 show the displacement and acceleration response of the SD OF structure in the frequency domain, respectively.

문장표절률: **0%**

It is verified that the displacement response of the SDOF structure was reduced by 82% for the case in the TMD control direction.

문장표절률: **0%**

The displacement con- trol performance index of a TMD is 0.18, as shown in Fig ure 2.47. Also, the acceleration response of the SDOF structure was reduced by 80 %, and the acceleration control performance index of a TMD is 0.20, as shown in Figure 2.48.

문장표절률: **0%**

Figures 2.47 and 2.50 show the displacement and acceleration response of the SD OF structure in the time domain, respectively.

문장표절률: **0%**

Also, the response of the SDOF structure tuned by the TMD is considerably reduce d at a resonance frequency of 0.82 Hz, as shown in Figure 2.49.

문장표절률: **0%**

Then, the test was carried out in the TLCD control direction. In this case, the freq uency of structural model was tuned to 0.73 Hz by connecting springs with the stif fness of 88,000 N/m to the moving mass of 4,250 kg.

문장표절률: **0%**

Figures 2.50 and 2.51 show the displacement and acceleration response of the SD OF structure in the frequency domain, respectively.

문장표절률: **0%**

It is observed that the displacement response of the SDOF structure was reduced b y 71% for the case in the TLCD control direction.

문장표절률: **0%**

The displacement control performance index of a TLCD is 0.29, as shown in Figu re 2.50. Also, the acceleration response of the SDOF structure was reduced by 70 %, and the acceleration control performance index of a TLCD is 0.30, as shown i n Figure 2.51.

문장표절률: **0%**

Also, the displacement response of the SDOF structure tuned by TLCD is consider ably reduced at a resonance frequency of 0.73 Hz, respectively, as shown in Figur e 2.52.

문장표절률: **0%**

2.6.7 Hybrid Testing Method of a Single Story Building Con− trolled by TLMD A TLMD is excited by uniaxial shaking table. Shear type load cell and acceleration sensors are attached on the shaking tableto monitor the dy− namic characteristic o f the shaking table.

문장표절률: **0%**

The vibration control and data 63 Chapter. 2. Hybrid Testing Method VDPOOD UPSOPUMSPM 'SFRVF O DZ)[Figure 2.47: Displacement in the frequency dom ain (TMD direction) acquisition are conducted using a real−time digital signal pr ocessor.

문장표절률: **0%**

The main task of the data acquisition board is dataconversion; it converts the mea sured shear force and acceleration to the digital data and converts the reference si gnal computed by the control program MATLAB to the analog data.

문장표절률: **0%**

An eight−channel data acquisitionsystem was adopted which uses an NI DAQcard −6036E board and a BNC−2110 BNC cable connector.

문장표절률: **0%**

At the hybrid testing method, the control performance results of the TLMD were e valuated. In this test, the checking point is whether the natural frequencies of the TLMD in the TMD and TLCD control direction were seen at 0.82 and 0.73 Hz, r espectively.

문장표절률: **0%**

Then, control performance of the bidirectional TLMD will be evaluated. First, the test was performed in the TMD control direction.

문장표절률: **83%**

Figures 2.53 and 2.54 show the displacement and acceleration response in the freq uency domain, respectively. It is observed that the displacement response of the sh aking table was reduced by 78% for the case in the TMD control direction.

[Copykiller] Design of a Bi−directional Tuned Liquid Mass Damper for Contro lling Dynamic Responses of Building Structures : 건축구조물의 동적응답제어를 위한 2방향 동조액체질량감쇠기 설계

저자 : 허재성
발행 : 서울 : 단국대학교 대학원, 2008

Fig.4.17 shows the displacement and acceleration response in the frequency domai n, respectively. It is observed that the displacement response of the shaking table was reduced by 78 for the case in the TMD control direction.

문장표절률: **40%**

The displacement control performance index of a TMD is 0.22, as shown in Figur e 2.53. Also, the acceleration response of the shaking table was reduced by 78%, a s shown in Figure 2.54.

[Copykiller] Design of a Bi−directional Tuned Liquid Mass Damper for Contro lling Dynamic Responses of Building Structures : 건축구조물의 동적응답제어를 위한 2방향 동조액체질량감쇠기 설계

저자 : 허재성
발행 : 서울 : 단국대학교 대학원, 2008

So, The displacement control performance index of a TMD is 0.22, as shown in Fi g.4.17(a). Also, the acceleration response of the shaking table was reduced by 78 %.

문장표절률: **59%**

Figure 2.55 shows the displacement in the time domain. The response of the shaki ng table is considerably reduced by 78% at a resonance frequency of 0.82 Hz.

[Copykiller] Design of a Bi−directional Tuned Liquid Mass Damper for Contro lling Dynamic Responses of Building Structures : 건축구조물의 동적응답제어를 위한 2방향 동조액체질량감쇠기 설계

저자 : 허재성
발행 : 서울 : 단국대학교 대학원, 2008

Displacement and acceleration in the time domain by the real−time hybrid test (T MD direction, 0.83Hz) Fig.4.18 shows the displacement and acceleration response in the time domain, respectively, the response of the shaking table is considerably reduced by 78% at a resonance frequency of 0.83 Hz.

문장표절률: **45%**

Then, the test was performed in the TLCD control direction. Figures 2.56 and 2.57 show the displacement and acceleration response of the shaking table in the frequency domain, respectively.

[Copykiller] Design of a Bi-directional Tuned Liquid Mass Damper for Controlling Dynamic Responses of Building Structures : 건축구조물의 동적응답제어를 위한 2방향 동조액체질량감쇠기 설계

저자 : 허재성
발행 : 서울 : 단국대학교 대학원, 2008

Fig.4.19 shows the displacement and acceleration response of the shaking table in the frequency domain, respectively. It is observed that the displacement response was reduced by 71 % for the case in the TLCD control direction, and the acceleration response reduced by 70 %.

문장표절률: **100%**

It is observed that the displace- ment response was reduced by 71% for the case in the TLCD control direc- tion, and the acceleration response reduced by 70%.

[Copykiller] Design of a Bi-directional Tuned Liquid Mass Damper for Controlling Dynamic Responses of Building Structures : 건축구조물의 동적응답제어를 위한 2방향 동조액체질량감쇠기 설계

저자 : 허재성
발행 : 서울 : 단국대학교 대학원, 2008

Fig.4.19 shows the displace ment and acceleration response of the shaking table in the frequency domain respectively. It is observed that the displace ment response was reduced by 71 for the case in the TLCD control direc tion, and the acceleration response reduced by 70 %.

문장표절률: **21%**

Also, the displacement and acceleration response of the shaking table are considerably reduced at 64 Chapter. 2. Hybrid Testing Method VDPOODUPSOPUMSPM 'SFRVF O DZ)[Figure 2.48: Acceleration in the frequency domain (TMD direction) V DP OODPUSOPUMSPM 5JN F T Figure 2.49: Displacement in the time domain (TMD direction, 0.82 Hz) a resonance frequency of 0.73 Hz, respectively, as shown in Figure 2.58.

[Copykiller] Design of a Bi-directional Tuned Liquid Mass Damper for Controlling Dynamic Responses of Building Structures : 건축구조물의 동적응답제어를 위한 2방향 동조액체질량감쇠기 설계

저자 : 허재성
발행 : 서울 : 단국대학교 대학원, 2008

Time (s) Time (s) Figure 4-20. Displacement and acceleration in the time domain by the real-time hybrid test (TLCD direction, 0.73 Hz) Also, the displacement and acceleration response of the shaking table are considerably reduced at a resonance frequency of 0.73 Hz, respectively.

문장표절률: **0%**

Comparisons of conventional experiment and hybrid testing method results In order to compare the control performances of the TLMD at the hybrid testing method and conventional method, J1, J2, J3, J4, are represented by 4USVDUVSF %JTQM BDFNFOU NN 65 Chapter.

문장표절률: **0%**

2. Hybrid Testing Method VDPOODUPSOPUMSPM 'SFRVF O DZ)[Figure 2.50 : Displacement in the frequency domain (TLCD direction) max [xc(t)] J1 = max [xu(t)] max [ẍc(t)] J2 = max [ẍu(t)] rms [xc(t)] J3 = rms [xu(t)] rms [ẍc(t)] J4 = rms [ẍu(t)] (2.47) (2.48) (2.49) (2.50) where xu and xc are uncontrolled displacement and controlled displace- ment, respectively.

문장표절률: **0%**

ẍu and ẍc are uncontrolled acceleration and controlled acceleration, respectively. Tables 2.6 and 2.7 show the control performance of the TLMD through the conventional test and hybrid test, respectively.

문장표절률: **0%**

According to the test result in the TLCD control direction, the errors of J1 or J2 between the results of the conventional test and hybrid test were all 0.01, but the errors of J3 or J4 between the conventional test and hybrid test were 0.03 and 0.04, respectively.

문장표절률: **0%**

In the TMD control direction, the errors of J1, J2, J3, J4 between the conventional test and hybrid test were 0.04, 0.02, 0.06, 0.06, respectively.

문장표절률: **0%**

66 Chapter. 2. Hybrid Testing Method OPUMSPM DPOUS 'SFRVF O DZ)[Figure 2.51: Acceleration in the frequency domain (TLCD direction) V DP OODUPSOPUMSPM 5JN F T Figure 2.52: Displacement in the time domain (TMD direction , 0 · 73 Hz) Table 2.6: Control performance of real-structure test TMD TLCD Effective mass 1.8% 0.8% Peak value J1 0.18 0.29 J2 0.20 0.30 RMS value J3 0.17 0.28 J4 0.17 0.27 4USVDUVSF %JTQMBDFNFOU NN 67 Chapter.

문장표절률: **0%**

2. Hybrid Testing Method VDPOODUPSOPUMSPM 'SFRVF O DZ)[Figure 2.53 : Displacement in the frequency domain by the hybrid test (TMD direction) VDP OODUPSOPUMSPM 'SFRVF O D Z)[Figure 2.54: Acceleration in the frequency domain by the hybrid test (TMD direction) Table 2.7: Control performance of hybrid testing method "DDFMFSBUJPO N TFD %JTQMBDFNFOU NN TMD Effective mass 1.8% Peak value J1 0.22 J2 0.22 RMS value J3 0.23 J4 0.23 TLCD 0.8% 0.30 0.29 0.31 0.31 68 Chapter.

문장표절률: **0%**

2. Hybrid Testing Method VDPOODUPSOPUMSPM 5 JN F T Figure 2.55: Displ acement in the time domain by the hybrid test (TMD direction, 0.83 Hz) %JTQM BDFNFOU NN VDPOODUPSOPUMSPM 'SFRVF O DZ)[Figure 2.56: Displace ment in the frequency domain by the hybrid test (TLCD direction) 69 Chapter. 2. Hybrid Testing Method VDPOODUPSOPUMSPM 'SFRV F O DZ)[Figure 2.57: Acceleration in the frequency domain by the hybrid test (TLCD direction) %JTQ MBDFNFOU NN VDPOODUPSOPUMSPM 5 JN F T Figure 2.58: Displacement in the time domain by the hybrid test (TLCD direction, 0.73 Hz) 70 Chapter.

문장표절률: **0%**

2. Hybrid Testing Method 3IZFCBSM JTEU SNVDFUUVISPFE 5JN F T Figure 2. 59: Uncontrolled displacement comparison in the time domain be- tween the real -structure test and hybrid testing method (TMD direction) 71 Chapter.

문장표절률: **0%**

2. Hybrid Testing Method 2.7 Summary In this chapter, a substructuring techniqu e, TLD-, TLCD- and TLMD- buildingstructure hybrid testing method for the sha king tabletest was proposed.

문장표절률: **0%**

The proposed testing technique adopts the upper part of the whole structure or non linear control devices as the experimental substruc- ture, which corresponds to a physical test model.

문장표절률: **58%**

The lower part of the whole structure or whole buildingstructure is modeled nume rically. In or- der to verify the validity and accuracy of the proposed technique, a shaking tabletest was conducted.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

In or der to verify the validity and accuracy of the proposed technique, a shaking tabletest was conducted. The result of the study can be summarized as follows.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

In or der to verify the validity and accuracy of the proposed technique, a shaking tabletest was conducted. The result of the study can be summarized as follows.

문장표절률: **75%**

The result of the study can be summarized as follows. 1. To reduce the distortion of the interface acceleration, the inverse trans- fer function of the shaking table was identified, and its statespace realization wasimplemented in the shaking table controller.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

(1 To reduce the distortion of the interface acceleration, the inverse trans fer function of the shaking table was identified and its statespace realization wasimplemented in the shaking table controller.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

(1 To reduce the distortion of the interface acceleration, the inverse trans fer function of the shaking table was identified and its statespace realization wasimplemented in the shaking table controller.

문장표절률: **100%**

2. In this paper, the linear transfer function approach for controlling themotion of a shaking table was considered to experimentally verify the proposed method for a linear experimental part.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

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저자 : 박은천
발행 : 서울: 檀國大學校, 2006

The result of the study can be summarized as follows. (1) The linear transfer function approach for controlling themotion of a shaking table was considered to experimentally verify the proposed method for a linear experimental part.

문장표절률: **58%**

However, this ap- proach would be inappropriate in a coupled non-linear system leading to experimental instability. Therefore, in such case, the controller us- ing the inverse transfer function of shaking table, shown in Figure 2.6, would be modi fied to compensate an experimental instability.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
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[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

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발행 : 서울 : 단국대학교 대학원, 2007.2

However, this ap proach would be inappropriate for a coupled non-linear system leading to experimental instability. Therefore, in such case the controller us ing th e inverse transfer function of shaking table, shown in Fig.

문장표절률: **95%**

3. The interface force between the experimental and numerical substruc- tures was obtained using only acceleration measurement and mass in- formation so that high-capacity loads cell and installation jigs are not required in the substructuring technique.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

11,would be modified to compensate an experimental instability. (3 The interface force between the experimental and numerical substruc tures was obtained using only acceleration measurement and mass in formation so that high-capacity loads cell and installation jigs are not required in the experiment.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

11,would be modified to compensate an experimental instability. (3 The interface force between the experimental and numerical substruc tures was obtained using only acceleration measurement and mass in formation so that liigh-capacity loads cell and installation jigs are not required in the experiment.

문장표절률: **73%**

4. The proposed method basing the interface force measurement on accel- eration measurements from an experimental substructure is partially available only when the mass distribution is discrete - for example, this technique would be applicable to the TMD as an experimental part.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

(4 The proposed method basing the interface force measurement on accel eration measurements from an experimental substructure is partially available only when the mass distribution is discrete - for example this would be applicable to the TMD as an experimental part.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

(4 The proposed method basing the interface force measurement on accel eration measurements fiom an experimental substructure is partially available only when the mass distribution is discrete - for example this would be applicable to the TMD as an experimental part.

문장표절률: **100%**

Also, the interface force measurement using force transducers is required to perform the proposed method when wind forces are applied to the experimental substructure.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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발행 : 서울 : 단국대학교 대학원, 2007.2

Also, the interface force measurement using force transducers is required to perform the proposed method when wind forces are applied to the experimental substructure.

문장표절률: **0%**

5. Experimental results demonstrate that the proposed substructuring technique can reproduce the dynamic behavior of the assumed whole structure.

문장표절률: **94%**

6. An unexpected vibration of the experimental substructure can be induced by the feedback of responses including its inherent natural modes and then by the error occurred in calculating the numerical substructure.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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(6) Unexpected vibration of the experimental substructure can be induced by the feedback of responses including its inherent natural modes and then by the error occurred in calculating the numerical substructure.

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발행 : 서울 : 단국대학교 대학원, 2007.2

(6) Unexpected vibration of the experimental substructure can be induced by the feedback of responses including its inherent natural modes and then by the error occurred in calculating the numerical substructure.

문장표절률: **56%**

72 Chapter. 2. Hybrid Testing Method 7. It is considered that to minimize the effect of natural modes of an experimental substructure on the substructured system, the structural model as heavily-damped as possible would be used as an experimental part.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

(2) It is considered that to minimize the effect of natural modes of an experimental substructure on the substructured system, the structural model as havily-damped as possible would be used as an experimental part.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

(2) It is considered that to minimize the effect of natural modes of an experimental substructure on the substructured system, the structural model as havily-damped as possible would be used as an experimental part.

문장표절률: **73%**

8. The proposed technique can be extended to the substructuring tech- nique with themiddle part of a whole structure in combination with the conventional substructuring technique employing lower part as the experimental substructure.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

REAL-TIME SUBSTRUCTURING TECHNIQUE possible would be used as an experimental part. (8 The proposed technique can be extended to the real-time substructuring tech nique with themiddle part of a whole structure in combination with the conventional substructuring technique employing lower part as the experimental substructure.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

REAL-TIME SUB STRUCTURING TECHNIQUE possible would be used as an experimental part. (8 The proposed technique can be extended to the real-time sub striictiuing tech nique with themiddle part of a whole structure in combination with the conventional substmctiuiiig technique employing lower part as the experimental substructure.

문장표절률: **82%**

9. The TLD installed on the top floor of the structure is physically tested, and simultaneously numerical calculation is carried out for the as- sumed analytical structural model.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

The TLD installed at the top floor of the structure is physically tested, and simultaneously numerical calculation is carried out for the as sumed analytical structural model.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

The TLCD installed at the top floor of the structure is physically tested, and simultaneously numerical calculation is carried out for the as sumed analytical structural model.

문장표절률: **26%**

10. Comparison between the structural responses obtained by the hybrid testing method and the conventional shaking tabletest of a single story steel frame with TLD and TLCD indicates that the performance of the TLD and TLCD can be accurately evaluated using the hybrid testing method without the physical structural model.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

Comparison between the structural responses obtained by the RHSTTM and the conventional shaking tabletest of a single story steel frame with TLD/TLCD indicates that the performance of the TLD/TLCD can be accurately evaluated using the RHSTTM without the physical structural model.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Comparison between the structural responses obtained by the RHSTTM and the c onventional shaking tabletest of a single story steel frame with TLD/TLCD indicates that the performance of the TLD/TLCD can be accurately evaluated using the RHSTTM without the physical structural model.

문장표절률: **88%**

11. The uncontrolled and TLD-controlled structural responses of a three- story structure are obtained by the hybrid testing method in both time and frequency domains, showing that TLD can effectively mitigate the seismic responses of buildingstructures and the hybrid testing method can reproduce the dynamic behavior of TLD-structure interactionsys- tems for both the uncontrolled and controlled case.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Finally the uncontrolled and TLD-controlled structural responses of a three story structure are obtained by the RHSTTM in both time and frequency domains, showing that TLD can effectively mitigate the seismic responses of buildingstructures and the RHSTTM can reproduce the dynamic behavior of TLD-structure interactionsys tems for both the uncontrolled and controlled case.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

Finally the uncontrolled and TLD-controlled structural responses of a three story stmcture are obtained by the RHSTTM in both time and frequency domains, showing that TLD can effectively mitigate the seismic responses of buildingstructures and the RHSTTM can reproduce the dynamic behavior of TLD-structure interactionsys tems for both the imcontroiled and controlled case.

문장표절률: **0%**

12. The hybrid testing method canalso be applied to the performance eval- uation of new designed, tuned liquid typed damper which has strong inherent nonlinearity such as TLMD.

문장표절률: **0%**

The bi-directional control performance of the TLMD was confirmed through the conventional and hybrid testing method. First, resonance fre- quencies in the TMD and TLCD control direction were confirmed at 0 · 82 and 0 · 73 Hz.

문장표절률: **0%**

In the TMD control direction (x-direction), 80% of the uncon- trolled peak response of the targetstructure was removed by a TLMD.

문장표절률: **0%**

Also, in the TLCD control direction (y-direction), 70% was removed by a TLMD. The control performances of the TLMD were checked and compared with the two testing methods.

문장표절률: **0%**

In the TLCD and TMD control direction, the er- rors of the peak values between the conventional and hybrid testing method were 0 · 01 and 0 · 02~0 · 04, respectively.

문장표절률: **0%**

Also, the errors of RMS values between the conventional testing method and hybrid testing method were up to 0 · 06. However, tuning error and outside environment are thought as the causes of the differences.

문장표절률: **0%**

The error of the convergence times reaching to the peak value as shown in Figure 2.59. This phenomenon is caused by the minute error of the mass, stiffness and damping ratio of the numerical 73 Chapter.

문장표절률: **0%**

2. Hybrid Testing Method analysis, which was thought for either reason. As showing the similar results of the two kinds of testing methods, the hybrid testing method, which does not require the physical structural model but with simple installation, as well as the conventional testing method, can accurately evaluate the control performance of a control device.

문장표절률: **0%**

74 Chapter 3 Design of Excitation System for Simulating Dynamic Loads 3.1 Design Controller of Excitation System for Sim- ulating Wind Responses In this section, simulation of wind-induced responses of a buildingstructure using linear mass shaker (LMS) and active tuned mass damper (ATMD) as an actuator is conducted as shown in Figure 3.1.

문장표절률: **0%**

For the linear actuator to keep the structure in the target response trajectory, an inverse transfer function of a structural response to the shaker force is obtained using a statespace form governing equation of the structure, and the discrete Fourier tr ansform of structural response is performed.

문장표절률: **0%**

Filter and envelope function are used such that the error between wind and actuator induced responses is minimized by preventing the shaker from actuating unexpected modal responses and initial transient responses.

문장표절률: **0%**

The effectiveness of the proposed method is verified through a numerical example of a 76 story-benchmark building excited by wind load of which deterministic time history is given.

문장표절률: **0%**

The effect of the type of the targetstructural response on a convergence of the actuator forcesignal and the error magnitude is investigated.

문장표절률: **0%**

3.1.1 Force of actuator Thestatespace form equation of a structure excited by wind load f and the shaker generated force u of size r is as follows.

문장표절률: **0%**

ż = Az + Bff + Buu (3.1) y = Cz + Dff + Duu where, z is thestate vector and y is the output vector of size m. The output transfer function to f or u is given by Tyf = Yf (s)F(s) −1 = C (sI−A)−1 Bf Tyu = Yu(s)U(s) −1 = C (sI−A)− (3.2)1 Bu 75 Chapter.

문장표절률: **0%**

3. Design of Excitation System for Simulating Dynamic Loads m L a Aicntievaer TMuansesd S Mhaaksesr Damper W 76 W 75 W 74 iFRF W 73 −1 T (s) Simulating W 2 W 1 Wind induced response Exciter induced Figure 3.1: Scheme of simulation of wind induced responses using LMS and ATMD where the scalar s is a complex variable jω .

문장표절률: **0%**

The inverse of Tyu exists only if r equalstom and the Laplace transform of u providing the identical output to wind load induced one is determined as U(s) = T−1yu Yu(s) (3.3) = T−1yuTyfF(s) when r is smaller than m, the number of structural responses which can be modulated by u is restricted to r and targetstructural response should be selected.

문장표절률: **0%**

The Laplace transform of input realizing the target response ȳ of size r is Ū(s) = T̄−1yu Ȳu(s) = T̄−1yu Ȳf (s) = T̄−1yu TyfF (s) (3.4) where, T̄−1yu is a sub-matrices of T−1yu is constructed by extracting the columns in T−1yu corresponding to the target response.

문장표절률: **0%**

Filter andevelop function The transfer function of structural response may have frequency intervals in which the magnitude is as small as zero, and in those intervals , the magni- 76 Chapter.

문장표절률: **0%**

3. Design of Excitation System for Simulating Dynamic Loads tude of the inverse transfer function increases infinitely.

문장표절률: **0%**

Because the input force is calculated by the product of the inverse transfer function and the output signal, significant input force may be calculated in order to realize the small magnitude of output components corresponding to the intervals.

문장표절률: **0%**

This force implies that the shaking system becomes very sensitive to the slight frequency variation of the outputsignal resulting from measurement noise and spectral leakage which is inevitable in signal processing using discrete Fourier transform, and then unnecessarily high input energy excites unex- pected frequency responses uch that target response may not be induced.

문장표절률: **0%**

Particularly, low-frequency component leads to a largestroke of the shaker. In this study, following band-stop filter (BSF) using cosine function is used to prevent the unexpected frequency response from occurring.

문장표절률: **0%**

Ūp(ω) = G(ω)Ū(s) (3.5) where, G(ω) = o (3.6) co c cos ω + 2 ω2 − ω1 2 aco = 1ω1 ≤ ω ≤ ω ⟩ ω2 2 : 0 (3.7) : 1 where, ω1 and ω2 are frequencies defining t he cut-off frequency interval, and aco is gain value of the cut-off frequency.

문장표절률: **91%**

Figure 3.2(a) shows the shape of the band-stop filter In discrete Fourier transform dealing with the finite duration discrete signal as an infinite one multiplied by a rectangular window, the originalsignal in time domain is distorted especially in initial and final time in- tervals.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Fig. 5.2(a) shows the shape of the band-stop filter In discrete Fourier transform dealing with the finite duration discrete signal as an infinite one multiplied by a rectangular window, the originalsignal in time domain is distorted especially in initial and final time i^crvals.

문장표절률: **59%**

This distortion can be reduced by using an envelope functionsuch that the given deterministic wind load has ascending and descending time intervals.

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This distortion can be reduced by using an envelop functionsuch that the given deterministic wind load has ascending and descending time intervals.

문장표절률: **98%**

Although the envelope function changes the deterministic wind load, the effect of this another distortion would be trivial in evaluating the characteristics of wind load induced response because the grave concern is generally in the intermediate time of the total loading duration when the peak response is expected to occur.

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Although the envelope function changes the deterministic wind load, the effect of this another distortion would be trivial in evaluating the characteristics of wind load induced response because grave concern is generally in the intermediate time of the total loading duration when the peak response is expected to occur.

문장표절률: **55%**

Figure 3.2(b) shows the shape of the envelope function used in this study. 3.1.2 Numerical Example 76 story wind-induced benchmark buildings The wind-induced responsesimulating actuator is applied to a 76-story 306 meters office tower benchmark building which is slender with a height to width ratio of 306.1/42 = 7.3.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

DESIGN OF AN ACTUATOR FOR SIMULATING WIND RESPONSE The wind-induced responsesimulating actuator is applied to a 76-story 306 meters office tower benchmark building which is slender with a height to width ratio of 306.1/42 = 7.3.

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저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

DESIGN OF AN ACTUATOR FOR SIMULATING WIND RESPONSE The wind-induced responsesimulating actuator is applied to a 76-story 306 meters office tower benchmark building which is slender with a height to width ratio of 306.1/42 = 7.3.

문장표절률: **25%**

Because the deterministic across-wind load 77 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads &OWFMPQ GVODUJPO 'SF RVFODZ) [t1 5JNF TFDPOE t2 (a) The shape of the band-stop filter (b) The shape of the envelop function Figure 3.2: Exciter gain shape of the band-stop filter and the envelop func- tion.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

0 1 c UJ t Time (second) i (b) The shape of the envelop function Figure 5-2 Exciter gain shape of the band-stop filter and the envelop func tion 66 5.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

Scheme of simulation of wind induced responses using LMS and ATMD ....64 Figure 5-2 Exciter gain shape of the band-stop filter and the envelop func tion.

문장표절률: **57%**

data is given through wind tunnel tests for this benchmark building, the force of the actuator realizes target across-wind induced structural response can be calculated using Eq.

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Because the deterministic across-wind load data is given through wind tunnel tests for this benchmark building, the force of the actuator force realizing target across-wind induced structural response can be calculated using Eq.(4).

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발행 : 서울: 檀國大學校, 2006

Because the deterministic across-wind load data is given through wind tunnel tests for this benchmark building, the force of the actuator force realizing target across-wind induced structural resp이lse can be calculated using Eq.(4).

문장표절률: **92%**

(3.4). In order to reduce numerical computation time, a 23 degree of freedom (DOF) state reduced-ordersystem model proposed by Yang et al.

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In order to reduce numerical computation time, a 23 degree of freedom (DOF) state rcduccd-ordcrsystem model proposed by Yang ct al.

문장표절률: **97%**

(2004b). is used in this study. The wind load vector is modeled physically by lumping wind forces on adjacent floors at the locations that correspond to the 23 DOF model.

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is used in this study. The wind load vector is modeled physically by lumping wind forces on adjacent floors at the locations that correspond to the 23 DOF model.

문장표절률: **73%**

Figures 3.3(a), 3.3(b) shows the plan view and elevation view of the 76th benchmark building and Figures 3.3(c), 3.3(d) show the mode shape of first three mode of the structure and time history of wind-load.

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저자 : 박은천
발행 : 서울: 檀國大學校, 2006

Fig.3 a), (b) shows the plan view and elevation view of the 76th benchmark building and Fig.3 c), (d) show the mode shape of first three mode of the structure and time history of wind-load.

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3 a), (b) shows the plan view and elevation view of the 76,h benchmark building and Fig.3 c), (d) show the mode shape of first three mode of the structure and time history of wind-load.

문장표절률: **92%**

3.1.3 Error evaluation criteria In order to verify the effectiveness of proposed method through the compar- ison between the wind and actuator induced structural responses, two error criteria are considered in time and frequency domains, respectively.

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5.4.2 Error evaluation criteria In order to verify the effectiveness of proposed method through the compar ison between the wind and actuator induced structural responses, two error criteria are considered in time and frequency domains, respectively.

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5A.2 Error evaluation criteria In order to verify the effectiveness of proposed method through the compar ison between the wind and actuator induced structural responses, two error criteria are considered in time and frequency domains, respectively.

문장표절률: **0%**

In time domain, the normalized tracking error is defined as] i△t)2 (3.8) &OW 1 Σ et = {za (i△t)- zf (i△t)}2 max zf (n i=0 where, △t denotes time interval, n denotes the data number.

문장표절률: **0%**

xa (i△t) and xf (i△t) are, respectively, actuator and wind induced structural resp onse at the ith time step. In frequency domain, the normalized tra/cking error is defined as N √ [√] 1 Σ e 2f = |Za (ωi)− Zf (ωi)| max |Zf (ωi)|2 (3.9) N i=1 where N is the number of frequency response data, and Xf (ω) and Xt(ω) are discrete-Fourier transformation of ẍf (t) and ẍt(t), which E [f (ω)] is normalized mean tracking error in frequency domain.

문장표절률: **0%**

78 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads (a) Plan View of the 76-Story Building 76 76 76 0 Mode 1 Mode 2 Mode 3 f= 0.160 Hz f = 0.765 Hz f = 1.992 Hz (b) Elevation View of the Building.

문장표절률: **0%**

900 450 0 -450 -900 900 450 0 -450 -900 900 450 0 -450 -900 0 150 300 450 600 750 900 Time, Sec. W 70, kN W60, kN W50, kN (c) Mode shapes of First Three Modes of (d) Time Histories of Wind Load on the Building.

문장표절률: **0%**

Floors 50, 60 and 70; W50, W60 and W70. Figure 3.3: 76th story benchmark model. LMS excitation In this subsection, an LMS which can produce arbitrary desired force is used as an actuator.

문장표절률: **0%**

LMS is assumed to have a mass of 500 metric ton and be 79 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads installed at 76th floor.

문장표절률: **0%**

The mass is identical to that of an ATMD used as a vibration dissipation device for the benchmark problem. The mass is about 45% of the top floor mass, which is 0.327% of the total mass of the building.

문장표절률: **0%**

Figures 3.4(a) and 3.4(b) show the transfer function of the 75th floor acceleration and displacement responses. It is observed that acceleration transfer function in Figure 3.4(a) has zero near the each modal natural fre- quency with slightly larger value than the corresponding natural frequency.

문장표절률: **0%**

Especially the zero exists near the first modal frequency which is expected to dominate the overall wind-induced structural responses. 'SF RVFO D Z) [(a) 75th story acceleration transfer function. '

문장표절률: **0%**

SF RVF O D Z) [(b) 75th story displacement transfer function.

문장표절률: **39%**

Figure 3.4: Transfer function of 75th story responses to LMS. Figure 3.5 shows the frequency response function and the time history of the actuator force obtained without using a filter when the target response is acceleration or displacement of the 75th floor.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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Transfer function of 75th story responses to LMS Fig. 5.5 shows the frequency response function and the time history of the actuator force obtained without using filter when the target response is acceleration or displacement of 75th floor.

문장표절률: **51%**

It is known from Figure 3.5 that much larger force are required for the shaker to achieve the target displacement than acceleration response, and furthermore there exist high- frequency components in Figure 3.4(b), which result in high-speedswitching of control force as shown in Figure 3.5(b).

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It is known from Fig. 5.5 that much larger force are required for the shaker to achieve the target displacement than acceleration response, and furthermore there exist high frequency components in Fig.

문장표절률: **85%**

In practice, hydraulic actuators popular in civil engineering structures is not suitable for this undesirable chattering problem which causes spillover instability in higher modes, and acceleration response concerned with service ability criteria is more critical for such high-rise building excited by wind load as this benchmark building]5' T]]5' T] 80 Chapter.

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5.4(d), which result in high speed-switching of control force as shown in Fig. 5.4(e). In practice, hydraulic actuators popular in civil engineering structures is not su itable for this undesirable chattering problem which causespillover instability in higher modes, and acceleration response concerned with service ability criteria is more critical for such high-rise building excited by wind load as this benchmark building than displacement.

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문장표절률: **67%**

3. Design of Excitation System for Simulating Dynamic Loads than displacement. Figure 3.6 shows the comparison between the frequency responses of wind and LMS induced 75th-floor acceleration and displace- ment when the target response is 75th displacement.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
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Fig. 5.6 shows the comparison between the frequency responses of wind and LMS induced 75th floor acceleration and displace ment when the target response is 75th displacement.

문장표절률: **73%**

It is obviously shown that the wind and LMD induced displacement coincide well with each other while acceleration responses are very different.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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It is obviously shown that wind and LMD induced displacement coincide well with each other while acceleration responses are very different.

문장표절률: **71%**

Based upon the observation in Figure 3.5 and 3.6, only acceleration response is considered as target re- sponse for calculating LMD force reproducing wind induced displacement as well as acceleration in this study.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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발행 : 서울: 檀國大學校, 2006

Based upon the observation in Fig. 5.5 and Fig. 5.6, only acceleration response is considered as target re sponse for calculating LMD force reproducing wind induced displacement as well as acceleration in this study.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Based upon the observation in Fig. 5.5 and Fig. 5.6, only acceleration response is considered as target re sponse for calculating LMD force reproducing wind induced displacement as well as acceleration in this study.

문장표절률: **0%**

'PSDF L/ 5J N F T F D PO E (a) LMS force targeting on 75th floor acceleration. 5J N F T F D PO E (b) LMS force targeting on 75th floor displacement.

문장표절률: **0%**

Figure 3.5: LMS force (unfiltered). Numerical analyses are conducted with/without using the filter and en- velope function for different target responses.

문장표절률: **0%**

Table 3.1 lists the cut-off fre- quencies used for canceling previously mentioned undesirable amplification effect by the zero in the inverse transfer function of each target response.

문장표절률: 0%

Envelope function with t1 = 100 second and t2 = 100 second is applied. Figure 3.7 shows the floor distribution of the time and frequency domain errors defined in the previous subsection, which are obtained with/without using the filter for different t arget responses.

문장표절률: 0%

Processed signal denotes one yielded by using the filter. It is identified from Figure 3.7 that the processed signal using filtersignificantly reduce the magnitude of the t racking error when the target response is 75-floor acceleration of which transfer f unction has band-stop frequency near the first modal frequency (as observed in Fi g- 'PSDF L/ 81 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads X-.JO4E JJOOEEVVDDFFEE 'SFRVF O D Z)[(a) Acceleration response.

문장표절률: 0%

X.JO - 4 E JJOOEEVVDDFFEE 'SFRVF O D Z)[(b) Displacement response. Fig ure 3.6: Frequency response of 75th floor with LMD force targeting dis- placeme nt response.

문장표절률: 43%

Table 3.1: Cutoff frequency for filter design Target response ω1 (rad/sec) ω2 (ra d/sec) 75th floor acceleration 1.01 1.13 50th floor acceleration 8.17 8.80 30th flo or acceleration 17.59 20.73 ure 3.4(a)) while the processing effect is trivial when t he target response is 30th or 50th floor acceleration of which transfer function has zero away from the first modal one.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

5.4(a)) while the processing effect is trivial when the target response is 30th or 50t h floor acceleration of which transfer function has zero away from the first modal one.

문장표절률: 97%

Also, it is known from observing the error dis- tribution that the targeted response s are almost identical to wind-induced ones with a small magnitude of error whil e the other non-targeted responses are slightly different withincreasing error.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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Also, it is known from observing the error dis tribution that the targeted responses are almost identical to wind-induced ones with small magnitude of error while th e other non-targeted responses are slightly different withincreasing error.

문장표절률: 100%

Targeting 30th or 50th-floor ac- celeration provides greater discrepancy between the wind and LMS induced 75-floor accelerations which are critical in evaluating service ability.

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Targeting 30th or 50th floor ac celeration provides greater discrepancy between th e wind and LMS induced 75-floor accelerations which are critical in evaluating s ervice ability.

문장표절률: 54%

The com- parison between the results in Figure 3.7(a) and 3.7(b) indicates that th e distribution tendency of et and ef is quite different and the magnitude of et is mu ch larger than that of ef .

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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발행 : 서울: 檀國大學校, 2006

The com parison between the results in Fig. 5.7(a) and (b) indicates that the 72 5. DESIGN OF AN ACTUATOR FOR SIMULATING WIND RESPONSE distributio n tendency of et and ef is quite different and the magnitude of et is much larger th an that of ef .

문장표절률: 95%

When targeting response is 75th floor acceleration, both values of et and ef are sm allest for the targeted 75th floor .BHOJUVEF .

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

When targeting response is 75th floor acceleration, both values of et and ef are sm allest for the targeted 75th floor acceleration, but the value of ef becomes larger fo r the otherstory responses while the value of er generally keeps the smallest except for 30th story acceleration.

문장표절률: 39%

82 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads acceler ation, but the value of ef becomes larger for the otherstory responses while the val ue of ef generally keeps the smallest except for 30th story accel- eration.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

When targeting response is 75th floor accel eration, both values of et and ef are s mallest for the targeted 75th floor accel eration, but the value of ef becomes larger for the otherstory responses while the value of er generally keeps the smallest exce pt for 30th story accel eration.

문장표절률: 61%

The larger value of et results from the phase difference between the wind and LM S induced responses since et is obtained based on the response difference at the sa me time step.

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저자 : 박은천
발행 : 서울: 檀國大學校, 2006

The larger value of et results from the phase difference between wind and LMS in duced responses since et is obtained based on the response difference at the same ti me step.

문장표절률: **41%**

The phase of the wind-induced response is not the important parameter in evaluating the wind resistance performance of a buildingstructure, ef can be said to be the more appropriate index for evaluating the wind response reproducing the performance of LMS.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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발행 : 서울 : 단국대학교 대학원, 2007.2

The phase of the wind induced response is not important parameter in evaluating the wind resistance performance of a buildingstructure, ef can be said to be more appropriate index for evaluating the wind response reproducing performance of LMS.

문장표절률: **24%**

U U I UI I P P P PP S PS S U U B UB S BS H SH FU VOQSPDFTTFE HFFUU VV OQSPDFTTFE UUII PPS UBSHFU Q OSPQDSFPTDFTTFE I PPPSS UUBBS TFE U SHHFFUU QQSSPPDDFFTTTTFEEE (a) et (b) ef Figure 3.7: Error distribution according to the filter usage and floor of target response.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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75 70 65 60 55 50 30 i 1 e Figure 5-7 Error distribution according to the filter usage and floor of target response 73 5. DESIGN OF AN ACTUATOR FOR SIMULATING WIND RESPONSE Figs.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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Frequency response of 75th floor with LMD forcetargeting DISPLACEMENT RESPONSE...71 Figure 5-7 Error distribution according to the filter usage and floor of target RESPONSE..73 Figure 5-8.

문장표절률: **71%**

Figures 3.8 and 3.9 compare the time histories of the wind and LMS induced structural responses for the cases that the target responses are, respectively, 75th and 30th-floor accelerations and filter are applied for the design of LMS.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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5.8 and 5.9 compare the time histories of the wind and LMS induced structural responses for the cases that the target responses are, respectively, 75th and 30th floor accelerations and filter is applied for the design of LMS.

문장표절률: **28%**

Figure 3.8 shows that the LMS induced acceleration response 83 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads including targeted 75th-floor acceleration agree well with wind-induced ones while displacement responses at all floors are undere observed in Figure 3.9 that the shaker simulated targeted 30th-floor ac- celeration as well as displacement responses but overestimates 75th-floor acceleration.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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Fig. 5.8 shows that the LMS induced acceleration response including targeted 75th floor acceleration agree well with wind-induced ones while displacement responses at all floors are underestimated by LMS.

문장표절률: **13%**

DFMFSBUJPO N T QMBDFNFOU N 5J N F T F D PO E 5 JN F TF DPO E (a) 76th story acceleration response (b) 76th story displacement response %JTQMB QMBDFNFOU N 5 JN F T F DPO E 5 JN F T F DPO E (c) 50th story acceleration response (d) 50th story displacement response %JTQMB X -.JO4E JJOOEEVVD DFFEE QMBDFNFOU N XFYJODJEU FJOS EJOVEDVFDEFE 5 JN F T F DPO

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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Wind and LMS induced acceleration responses (when the target is 75th floor acceleration)...74 Figure 5-9. Wind and LMS induce

E 5 JN F T F DPO E (e) 30th story acceleration response (f) 30th story displacement response Figure 3.8: Wind and LMS induced acceleration responses (when the target is 75th floor acceleration).

d acceleration responses (when the target is 30th floor acceleration)..................... ....75 Figure 5-10.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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Error distribution according to the filter usage and floor of target RESPONSE....... ....th..73 Figure 5-8 Wind and LMS induced acceleration responses (when the target is 75th floor acceleration)..................... ....74 Figure 5-9.

문장표절률: **95%**

3.1.4 ATMD excitation In the 76th story building benchmark problem, ATMD is used as an example controller, which is composed of spring and viscous damper in addition to the mass and actuator of the LMS.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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Wind and LMS induced acceleration responses (when the target is 30th floor acceleration) 5.4.4 ATMD excitation In the 76th story building benchmark problem, ATMD is used as an example controller, which is composed of spring and viscous damper in addition to the mass and actuator of the LMS.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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Wind and LMS induced acceleration responses (when the target is 30th floor acceleration) 5-4.4 ATMD excitation In the 76th story building benchmark problem, ATMD is used as an example controller, which is composed of spring and viscous damper in addition to the mass and actuator of the LMS.

출처표시 문장 문장표절률: **0%**

In this subsection, the ATMD is considered as another exciter. The mass of the ATMD is 500 metric ton, and the undamped natural frequency and damping ratio are, respectively, 0.16Hz and 20%(Yang et al., 2004b).

문장표절률: **0%**

Simplification for the control environments have been made, in particular, the actuator dynamics and controller-structure interaction are not considered in the benchmark problem.

인용포함 문장 문장표절률: **0%**

The equation of motion of the building equipped with an ATMD on the top floor can be expressed as Mẍ + Cẋ + Kx + Hu = ηW (3.10) "DDFM %JTQMB 84 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads JTQMBDFNFOU N 5 JN F T F DPO E 5J N F T F D PO E (a) 76th story acceleration response (b) 76th story displacement response %JTQM QMBDFNFOU N 5J N F T F D PO E 5J N F T F D PO E %JTQM (c) 50th story acceleration response (d) 50th story displacement response XFYJODJEU FJOS EJOVEDVFDEFE N X-.JO4E JJOOEE VVDDFFEE QMBDFNFOU N 5J N F T F D PO E 5J N F T F D PO E (e) 30th story acceleration response (f) 30th story displacement response Figure 3.9: Wind and LMS induced acceleration responses (when the target is 30th floor acceleration). and considering no wind-load input, the equation of motion of the build- "DDFM

문장표절률: **0%**

%JTQM ing can be expressed as [ ]{ } [ ]{ } Ms 0 ẍs C ẋ+ s + ctBtB 〉 t -ctBt s 0 mt ẍt [-c 〉 +tBt ct ẋt Ks (3.11) u t t t t t s t -ktB〉t kt xt 1 where Bt is position vector of floor installed ATMD, Ms, Cs and Ks is

문장표절률: **0%**

the mass, damping coefficient and stiffness matrix of the structure and mt, ct and kt is the mass, damping coefficient and stiffness of the ATMD.

문장표절률: **0%**

Figure 3.10(a) shows the transfer function of the 75th-floor acceleration to the absolute acceleration the ATMD. No zero point is observed in the vicinity of the first modal frequency unlike the case for LMS, which indicates that band-stop filter is not required for preventing the ATMD to excite the unexpected frequency response.

문장표절률: **0%**

Figure 3.10(b) shows the frequency response of the actuator force of the ATMD and Figure 3.10(c) and 3.10(d) show the frequency and time responses of the effective force applied to the structure by the ATMD.

문장표절률: **0%**

85 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads]5' T]]6 T] 'SF RVFODZ) ['SF RVFODZ) [(a) Transfer function of ATMD induced (b) Frequency response of ATMD acceler- structure ation]6 T] '03$& L/ ' S FRV FODZ)[5 J N F T F DPO E (c) Frequency response of ATMD actuator (d) Time history of ATMD actuator force force Figure 3.10: ATMD Excitation.

문장표절률: **91%**

Figure 3.11 shows the time history comparison between wind induced acceleration and ATMD induced one targeting on 75th story acceleration response.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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Wind and ATMD induced acceleration responses (when the targetis 75th floor acceleralion) Fig. 5.11 shows the time history comparison between wind induced acceleration and ATMD induced one targeting on 75th story acceleration response.

문장표절률: **100%**

All acceleration responses coincide well with each other, but in displace- ment response, there exists slight underestimation and overestimation ac- cording to the time ranges.

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All acceleration responses coincide well with each other, but in displace ment response, there exists slight underestimation and overestimation ac cording to the time ranges.

문장표절률: **93%**

Figure 3.12 shows the comparison between the frequency responses of 75th floor acceleration and it is observed that wind and ATMD induced responses show good agreement overall frequency range.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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oo-o-oo.;o.<-0.-0.:o ^ (2S/U0 uollejalsov uo!J2ala).8v QS/트 uojjejalasv 77 5. DESIGN OF AN ACTUATOR FOR SIMULATING WIND RESPONSE Fig. 5.12 shows the comparison between the frequency responses of 75th floor acceleration and it is observed that wind and ATMD induced responses show good agreement overall frequency range.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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(uo Hia>Ea>oelQ.SIQ -0-0 수 S/E) uo!J2c)laoov 77 5. DESIGN OF AN ACTUATOR FOR SIMULATING WIND RESPONSE Fig. 5.12 shows the comparison between the frequency responses of 75th floor acceleration and it is observed that wind and ATMD induced responses show good agreement overall frequency range.

문장표절률: **94%**

Figure 3.13 shows the error distribution according to the floor of targeted acceleration response. From Figure 3.13(b) showing that ef has the smallest value over floors when the target response is 75th floor acceleration, and the corresponding value ranges only between 1% and 10%, ATMD targeting 75th floor acceleration can be said to provide the best performance, and it can exactly reproduce the wind-induced acceleration response of all floors including targeted 75th floor.

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[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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문장표절률: **58%**

3.1.5 Comparison between LMS and ATMD Figure 3.14 shows time history of the actuator forces in LMS and ATMD excitation systems.

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발행 : 서울: 檀國大學校, 2006

Enor Distribution with ATMD excitation 5.4.5 Comparison between LMS and ATMD Fig. 5.14 shows time history of the actuator forces in LMS and ATMD excitation systems.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

5.14 shows time history of the actuator forces in LMS and ATMD excitation systems. The peak actuator force required for ATMD is larger than that for LMS.

문장표절률: **50%**

The peak actuator force required for ATMD is larger than that for LMS. Figure 3.15 compares the stroke of LMS with/without filter and ATMD.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
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발행 : 서울 : 단국대학교 대학원, 2007.2

5.14 shows time history of the actuator forces in LMS and ATMD excitation systems. The peak actuator force required for ATMD is larger than that for LMS.

문장표절률: **100%**

The stroke of LMS with filter is much smaller than those of LMS without filter and ATMD. This fact implies that ATMD requires largestroke to show good performance in wind-induced response realization and this stroke requirementshould be checked in the design of ATMD.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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저자 : 박은천
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This fact implies that ATMD requires largesiroke in order to show good performance in wind-induced response realization and this stroke requirementshould be checked in the design of ATMD.

인용포함 문장 문장표절률: **13%**

86 Chapter. 3. Design of Excitation System for Simulating Dyna 5J N F T F DPO E 5 JN F TFDPO E %JTQMBDFNFOU N ic Loads (a) 76th story acceleration response (b) 76th story displacement response 5 JN F T F DPO E 5 JN F TFDPO E %JTQMBDFNFOU N (c) 50th story acceleration response (d) 50th story displacement response X"5JO.E% JO JEOVEDVFDEFE N X"5JO.E %JO JEOVEDVFDEF E 5J N F T F DPO E 5 JN F TFDPO E %JTQMBDFNFOU N (e) 30th story acceleration response (f) 30th story displacement response Figure 3.11: Wind and ATMD induced acceleration responses (when the target is 75th floor acceleration).

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

ATMD Excitation..76 Figure 5-11 Wind and ATMD induced acceleration responses (when the target is 75th floor acceleration) ....77 Figure 5-12.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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Wind and ATMD induced acceleration responses (when the target is 75th FLOOR ACCELERATION)..77 Figure 5-12. Frequency response of wind and ATMD induced 75th floor ACCHLHRATIONS................ ....78 Figure 5-13.

문장표절률: **70%**

Table 3.2 shows thenumerical values of the error, actuator force, and actuator stroke in LMS with/without the filter, and ATMD systems.

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발행 : 서울: 檀國大學校, 2006

Comparison between actuator forces in LMS and ATMD s 3>laili(0 M i>io 리is {s 3>IOiL^ {n>0 80 5. DESIGN OF AN ACTUATOR FOR SIMULATING WIND RESPONSE Table 5.2 shows thenumerical values of the error, actuator force, and actuator stroke in LMS with/without filter, and ATMD systems.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Stroke Comparison o?} SOHrs d) bet sLuocco 니I ?) 3>l이iLS Fi] 80 5. DESIGN OF AN ACTUATOR FOR SIMULATING WIND RESPONSE Table 5. 2 shows thenumerical values of the error, actuator force, and actuator stroke in LMS with/without filter, and ATMD systems.

문장표절률: **100%**

The errors are obtained when the target and evaluation responses are identical, and actuator force and stroke are obtained when the target response is 75th- floor acceleration.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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The errors are obtained when the target and evaluation responses are identical, and actuator force and stroke are obtained when the target response is 75th floor acceleration.

문장표절률: **56%**

The facts observed from Figures 3.14 and 3.15 that the performance of LMS can be enhanced using the band-stop filter and ATMD reproduces wind-induced response better than LMS, but ATMD requires larger actuator force and stroke can be identified once more.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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발행 : 서울: 檀國大學校, 2006

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The facts observed from Figs. 5.14 and 5.15 that the performance of LMS can be enhanced using band-stop filter and ATMD reproduces wind-induced response better than LMS but ATMD requires larger actuator force and stroke can be identified once more.

문장표절률: **80%**

3.1.6 Summary The design of excitation systems for simulating wind-induced responses of a buildingstructure was presented as a preliminary study for evaluating wind-resistance characteristics of buildingstructures.

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발행 : 서울 : 단국대학교 대학원, 2007.2

Table 5-2. Comparison between LMS and ATMD LMS (unfiltercd) LMS (filtered) ATMD 75lh floor acceleration er 0.117 0.192 0.074 ef 0.054 0.011 0.003 50th floor acceleration e, 0.081 0.081 0.083 ef 0.219 f? 0.213 0.525 30th floor acceleration e, 0.082 0.082 0.082 ef 0.034 0.033 0.065 Stroke Peak (m) 1.402 0.519 1.265 RMS (m) 0.436 0.183 0.333 Actuator force Peak (kN) 1068.22 441.68 655.78 RMS (kN) 323-92 136.44 170.39 5.5 Concluding Remarks Design of excitation systems for simulating wind induced responses of a buildingstructure was presented as a preliminary study for evaluating wind-resistance characteristics of practical buildingstructures.

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문장표절률: **100%**

The actuator forces of the LMS and ATMD were obtained using the inverse transfer function of structural responses. Also, band stop filter was used in LMS to remove zero of the transfer functionsuch that undesirable modal excitation is prevented and envelop function was used to reduce the error occurring in transient initial states in both LMS and ATMD.

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문장표절률: **89%**

The numerical analyses results from a 76-story benchmark building confirmed th at the structural responses of a 87 Chapter.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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발행 : 서울 : 단국대학교 대학원, 2007.2

The numerical analyses results from a 76-story benchmark building confirmed th at the structural responses of a buildingstructure excited by wind loads acting at al l floors could be reproduced by the proposed linear shaker installed at a specific fl oor.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

The 81 5. DESIGN OF AN ACTUATOR FOR SIMULATING WIND RESPONSE numerical analyses results from a 76-story benchmark building confirmed that th e structural responses of a buildingstnicture excited by wind loads acting at all flo ors could be reproduced by the proposed excitation systems installed at a specific f loor.

인용포함 문장 문장표절률: **0%**

3. Design of Excitation System for Simulating Dynamic Loads .BHOJUVEF X"5J O.E% JO JEOEVDVFDEFE 'SF RVF O DZ) [Figure 3.12: Frequency response of wind and ATMD induced 75th floor accelerations (a) et 'MPPS UUII PPPPSS UUB BSSHHFFU UI PPS UBSHFUU (b) ef 'MPPS Figure 3.13: Error Distribution with A TMD excitation. 88 Chapter. 3. Design of Excitation System for Simulating Dyna mic Loads -".5.4 %GP GSPDSFDF

문장표절률: **0%**

5 J N F T F DPO E Figure 3.14: Comparison between actuator forces in LMS and ATMD Table 3.2: Comparison between LMS and ATMD LMS (unfil- LMS (fil- ATMD tered) tered) 75th floor ac- et 0.117 0.192 0.074 celeration ef 0.054 0.011 0.003 50th floor ac- et 0.081 0.081 0.083 celeration ef 0.219 0.213 0.525 30th flo or ac- et 0.082 0.082 0.082 celeration ef 0.034 0.033 0.065 Stroke Peak (m) 1.40 2 0.519 1.265 RMS (m) 0.436 0.183 0.333 Actuator Peak (kN) 1068.22 441.68 6 55.78 force RMS (kN) 323.92 136.44 170.39 buildingstructure excited by wind lo ads acting at all floors could be repro- duced by the proposed excitation systems i nstalled at a specific floor.

문장표절률: **0%**

The performances of the excitation systems were dependent on type and position o f the targetstructural response for which acceleration response was suit- able beca use targeting displacement response required large and high-speed changing contr ol force.

문장표절률: **0%**

'03$& L/ 89 Chapter. 3. Design of Excitation System for Simulating Dynamic Lo ads 0,& N 5 J NF T FDP O E (a) LMS stroke (unfiltered) 30,& N 4 5 J NF T FD P O E (b) LMS stroke (filtered) 530,& N 4 5 J N F T F DPO E (c) ATMD stroke Figure 3.15: Stroke Comparison.

문장표절률: **0%**

3.2 Forced vibration test of full-scaled five-story building structuresimulating eqa rthquake re- sponses 3.2.1 Overview In this section, the hybrid mass damper (H MD) controller for the pseudo- earthquake excitation test is designed by employin g the method using the inverse transfer function of a structure, which is one of the methodologies 4 90 Chapter.

문장표절률: **0%**

3. Design of Excitation System for Simulating Dynamic Loads proposed by the pr evious section and is verified for its experimental im- plementation.

문장표절률: **0%**

First, a real scaled five-story steel frame, in which an HMD installed, is shaken a nd then transfer functions from the HMD to structural responses of each story are obtained.

문장표절률: **0%**

Then, the FE model numerically cal- culated from the software for commercial us e is renewed based on the modal information extracted from experimentally obtai ned transfer functions.

문장표절률: **0%**

Also, the earthquake responses based on the renewed structural model are numer- ically calculated, and the structure is excited by an HMD inputsignal which is pro duced to simulate a specific target response of a structure out of these numerically calculated earthquake responses.

문장표절률: **0%**

Finally, the effectiveness of pseudo-earthquake excitation presented in this study is verified by compar- ing numerically calculated seismic responses with experimentally measured ones.

문장표절률: **0%**

The pseudo-earthquake excitation testing method presented in this study has a few importance in an engineering aspect.

문장표절률: **0%**

First, the testing method that is performed for a real scalestructure in the field is free from lots of artificial constraints accompanied in a laboratory test.

문장표절률: **100%**

Secondly, valuable data, which are available for the verification of structural seismic performance and the evaluation of the availability of vibration technique required in structural health monitoring, can be acquired from the test.

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저자 : 박은천
발행 : 서울: 檀國大學校, 2006

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Secondly, valuable data, which are available for the verification of structural seismic performance and the evaluation of the availability of vibration technique required in structural health monitoring, can be acquired from the test.

문장표절률: **72%**

Thirdly, large shaking table is not required to evaluate the seismic response of real-scaled build- ing structures, since in this study the earthquake response is simulated by actuating a structure with an HMD installed at the upper story.

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Thirdly, large shaking table is not required to evaluate the seismic response of real-scaled build ing structures, since in this study the earthquake response is simulated by exciting a structure with a HMD installed at upper story.

문장표절률: **84%**

3.2.2 Experimental Real-Scale Building Model The experimental model, which is shown in Figures 3.16 and 3.17, is a full- scale five-story steel structure which has the story height of 6m, the plan of 6m x 6m, and the story mass of 20,000kg.

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6.2 Experimental Real-Scale Building Model The experimental model, which is shown in Figure 3, is a full- scale five-story steel structure which has the story height of 6m, the plan of 6m x 6m, and the story mass of 20,000kg* Each floor is composed of four identical wide-flange type steel columns.

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6.2 Experimental Real-Scale Building Model The experimental model, which is shown in Figure 3, is a fhll- scale five-story steel structure which has the story height of 6m, the plan of 6m x 6m, and the story mass of 20,000kg.

문장표절률: **41%**

Each floor is composed of four identical wide-flange type steel columns. An HMD using larger scale linear motor damper which was also designed as a passive damper has a moving mass on the fifth floor excited the modelstructure.

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A HMD using larger scale linear motor damper which was also designed as a pas sive damper has moving mass on the fifth floor excited the modelstructure.

문장표절률: **45%**

Because the columns consist of I-shaped steel, the HMD was installed in minor ax is of the structure. 3.2.3 Field measurement and experimental system Field measur ement and experimental system is shown in Figures 3.18 and 3.19.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Because the columns consist of I-shaped steel, the HMD was installed in minor ax is of the structure. 85 6. FORCED VIBRATION TEST OF REAL-SCALE FIVE ST ORY STRUCTURE © © © © T m ㅜ 3200 ㅜ 6C00 85S ㅜ LLi ≫.

문장표절률: **94%**

In order to minimize the latency between the excitation and the mea- surement, o ne lap-top PC in the experimental system was used for simul- taneously impleme nting the excitation and the measurement.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

6.3 and 6.4. To minimize the latency between the excitation and the mea suremen t, one lap-top PC in the experimental system was used for simul taneously imple menting the excitation and the measurement.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

6.3 and 6.4. To minimize the latency between the excitation and the mea suremen t, one lap-top PC in the experimental system was used for simul taneously imple menting the excitation and the measurement.

문장표절률: **100%**

The measure- ment system has accelerometers, PCB Corp. 393B12 model was inst alled at the center of the 2nd 5th floor and KYOWA Corp.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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The measure ment system has accelerometers, PCB Corp. 393B12 model was insta lled at the center of the 2nd 5th floor and KYOWA Corp.

문장표절률: **22%**

AS-2GB model was attached to the HMD. PCB Monitran and KYOWA DPM-71 1B was used 91 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads 9 9 : : (*35)) 9(- !$ 9 9 9 (300' $ $ $ (- # (# 5) $ $ $ (- (5) $ $ $ (- (3% $ $ $ (- (/% $ $ $ (- 45 '$ '$ '$ ' 9 9 $(*35) (- ! 9 9 9 (300' $ (- (# 5) $ (- (5) $ (- (3% $ (- (/% $ (- 45 '$ ' 4 .*/03 "9 & 4 4 ."+03 "9 & 4 (a) minor axis (b) major axis Figure 3.16: Elevation view of the targetstructure.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

AS-2GB model was attached to the HMD. PCB Monitran and KYOWA DPM-71 1B was used to amplify their measured signals. The data cabling connection syste m has BNC cable with lengths of 25m and 50m.

문장표절률: **55%**

to amplify their measured signals. The data cabling connection system has BNC c able with lengths of 25m and 50m. In the data acquisitionsystem, the DAQ board of NI DAQCard-6036E with 16bit-range was used to perform the AD and DA co nversion.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

In the data acquisitionsystem, the DAQ board of NI DAQCard-6036E with 16bit -range was used to perform the AD and DA conversion.

문장표절률: **92%**

Also, it was connected to the signal conditioner of NI SCC-2345 by using both the input modules and the output module. 92 Chapter.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Also, it was connected to the signal conditioner of NI SCC-2345 by using both the input modules and the output module. In this excitation system, both excitation an d measurement signals arevoltage signals and this excitation signal transfer^equiv alent thrust generated according to the input voltage signal through the inverter of HMD, to the mass of HMD.

문장표절률: **0%**

3. Design of Excitation System for Simulating Dynamic Loads ' SFRVFODZ) [(a) Five-story building structure. (b) Transfer function of target floor re- sponse to th e HMD.

문장표절률: **0%**

Figure 3.17: Photograph and transfer function of the target buildingstruc- ture. Ta ble 3.3: Member list of the modelstructure MEMBER LIST C1 H-310x310x20x20 G1 H-400x200x8x13 G2 H-450x200x9x14 B1 H-200x100x5.5x8 B2 H-400x20 0x8x13 RB1 H-400x200x8x13 FC1 500x500 In this excitation system, both excita tion and measurement signals arevolt- age signals, and this excitation signal tran sfers equivalent thrust generated according to the input voltage signal through the inverter of HMD, to the mass of HMD.

문장표절률: **0%**

Accordingly, the excitation signal should be generated to move within the safety r ange, because the excessive response of the HMD is prevented by its safety device.

문장표절률: **0%**

3.2.4 System Identification White-noise Test White noise vibration test was carrie d out by using broad-band random signals during 410sec.

문장표절률: **0%**

Both the excitation and measurement were performed by constructing a close-loo p system to minimize the latency, by which time 93 Chapter.

문장표절률: **0%**

3. Design of Excitation System for Simulating Dynamic Loads Targetstrcuture Me asurementsystem DAQ system HMD Excitation system accelerometer amplifier P CB voltagePCB A/D Board meapsousriteimonent ConSdigitnioanler PT & CT FGu enncetriaotnor (VoCltoangter, oFl rSeiqguneanlcy) Aluminum Ironcore Inverter Fi xedcoil Moving Mass AC 220 V cvuorltraenget displacement LimitSwitch LimitS witch Modal Testing Tower Figure 3.18: Schematic diagram of the field measure ment, data acquisition and excitation system.

문장표절률: **0%**

(a) The measurement and data acquisition (b) The accelerometer installationsyste m Figure 3.19: Installation pictures of the measurement, data acquisition and exci tation system.

문장표절률: **0%**

delay would be induced, and experimental data was acquired with a sampling rat e of 100Hz. In order to reduce the unexpected noise in the experiment, a low-pass filter of 30Hz within the amplifier and 25Hz within the signal conditioner module was utilized, and the acquisitionsystem was insulated with the reference signal end ed (RSE) method for its grounding.

문장표절률: **0%**

Figure 3.20 shows the transfer function from the absolute acceleration of the HM D to the building accelerations. The lower fundamental modes of the structure are apparently shown.

문장표절률: **0%**

Finite Model Updating It is difficult to establish the FE model because of limitatio ns in the number of sensors that may be deployed and the difficulty of actuating a structure to 94 Chapter.

문장표절률: **0%**

3. Design of Excitation System for Simulating Dynamic Loads UI UPQ UUII PPS S OEE P P P PP S PS S 'SFRV FODZ) [Figure 3.20: The transfer function from the absolute acceleration of the HMD to those of the structure.

문장표절률: **0%**

Table 3.4: Identified natural frequencies and damping ratios Modes Frequency (H z) & COV Damping ratio (%) & 5SBOTGFS ' (%) COV (%) 1 0.52(1.82) 1.46(14 .42) 2 1.73(0.13) 2.71(9.40) 3 2.94(0.10) 3.54(1.93) 4 4.14(0.08) 1.72(1.70) 5 5. 36(0.23) 3.84(3.56) higher modes.

출처표시 문장 문장표절률: **0%**

The process of developing an FE model of a structure relating it to the experiment al modelis called FE model updating(Bagchi, 2005).

문장표절률: **0%**

In this paper, an analysis model was established by modeling using ANSYS and model updating was carried out by using the measured modal data.

출처표시 문장 문장표절률: 0%

In this paper, the optimal matrix update method was used which is based on a constraint optimization problem where the minimum changes in the mass matrix or the stiffness matrix are found subject to constraints such as symmetry, connectivity, and definiteness(Baruch, 1978; Baruch and Bar Itzhack, 1979).

문장표절률: 0%

The mass matrix is assumed to be exact. There exists a constraint on the corrected stiffness matrix which should reproduce the measured modal data with symmetry.

문장표절률: 0%

The two independent constraint equa- tions are Eqs. (3.12) and (3.13). The function to be minimized must relate in some way to the difference between the corrected stiffness matrix, K, and the analytically derived stiffness matrix, Ka, which is shown in the form of the norm in Eq.

문장표절률: 0%

(3.14). The expression for the updated mode and stiffness matrix, which is obtained by minimizing Eq. (3.14) satisfying Eqs. (3.12) and (3.13), lead to Eqs.

출처표시 문장 문장표절률: 0%

(3.15) and (3.16)(Baruch and Bar Itzhack, 1979; 95 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads Baruch, 1978).

문장표절률: 0%

KΦ = MaΦΛ, Φ 〉MaΦ = I (3.12) K〉 = K (3.13) J = (K- 1 ‖ ‖ ‖N-1 2 ‖ a) - 1‖ ‖ (3.14) [ ]-1/2 Φ = Φm Φ 〉 mMaΦm (3.15) K = Ka -KaΦΦ〉Ma -MaΦ Φ〉Ka + MaΦΦ 〉 (3.16)KaΦΦ〉Ma + MaΦΛΦ〉Ma where, Ma and Ka are the analytically derived mass matrix and stiffness matrix, respectively, Φm is the measured eigenvector matrix, Λ is a diagonal matrix of the measured eigenvalues and N is the appearance of the square 1/2 root of the mass matrix N = Ma .

문장표절률: 0%

In this study, as shown in Figure 3.20, the measured eigenvector is ex- tracted from the measured modal data using respectively accurate the first and the second modal information.

문장표절률: 0%

When the measured eigenvector matrix would be extracted, it could be extracted from the transfer function in case of modal resonance using Eq.

문장표절률: 0%

(3.17) and the sign of the eigenvector are de- termined from the phase of the transfer function. Reinhorn et al. assumed that resonance responses of the each mode are dependent in case the modal frequencies are not adjacent each other and proposed equation of the transfer function, which is expressed as Tai (ωk) = φikHik (ωk) Γk (3.17) where, Tai (ωk), Hik (ωk) are the transfer functions to the ith floor and the kth mode of structures in case of resonance and not, Γk is the kth scalar value of Γ = -Φ〉MaI and I is the influence vector of HMD load.

문장표절률: 0%

The kth value of eigenvector by ratio of the ith floor over the jth floor can be calculated from amplitude ratio of the transfer function to absolute acceleration responses, which is expressed as φik/φjk = Tai (ωk) /Taj (ωk) (3.18) By updating the natural frequencies and modes, the exactresults are obtained comparing to those of the initial analysis.

문장표절률: 0%

96 Chapter. 3. Design of Excitation System for Simulating Dynamic LoadsTable 3.5: Natural frequencies (Hz) for the modal testing tower 1st mode 2nd mode 3rd mode 4th mode 5th mode initial 0.5022 1.5623 2.74 measured 0.5249 1.7578 2.94 updated 0.5249 1.7578 2.95 TU NPEF NB TT OPSNB MJ[FE NPE F TIBQF Y (a) 1st mode shape 4UPSZ 4UPSZ 3.91 4.83 3.67 5.38 3.67 5.38 OE NPEF .*6OF QJU B EJB TVSFE NPEFM BMU F'E& 'N&P NEFPMEFM N B TT OPSNB MJ[FE NPE F TIBQF Y (b) 2nd mode shape Figure 3.21: The mode shape comparison of initial, the measured and the updated FE models.

문장표절률: 0%

3.2.5 Design Controller of an Excitation System for Simu- lating Earthquake Response Generating InputSignal of HMD In this chapter, the process of generating the HMD input signal which is simulating earthquake response in the elastic range of modelstructure by HMD is introduced.

문장표절률: **0%**

Thestate-space form equation of a structure excited by the base acceleration üb a nd HMD acceleration üh with size of r is expressed as follows ż = Az + Bbüb + Bh üh (3.19) y = Cz + Dbüb + Dhüh where z is state variable vector size of 2nx1 and y is output vector with 97 Chapter.

인용포함 문장 문장표절률: **0%**

3. Design of Excitation System for Simulating Dynamic Loads PEFM .% TU 'MPP S "DDFMFSBUJPO *O J U JB M '& .PEFM .FBTV S F E .PEFM 6 QEBUF E ' & .).% (a) Transfer function of HMD to 1st floor acceleration PEFM .% OE 'MPPS " DDFMFSBUJPO *O J U JB M '& .PEFM .FBTVSFE .PEFM'SFRVFODZ) [6 QEB UF E ' & . (b) Transfer function of HMD to 2nd floor acceleration *O J U JB M ' & .PEFM .FBTV S F E .PEFM 6QEBUFE '& .PEFM'SFRVFODZ)[(c) Transfer fu nction of HMD to 3rd floor acceleration PEFM % UI 'MPPS "DDFMFSBUJPO).% SE 'MPPS "DDFMFSBUJPO *O J U JB M '& .PEFM .FBTVSFE .PEFM 6QEBUFE ' & .'SFRVFODZ) [

문장표절률: **0%**

(d) Transfer function of HMD to 4th floor acceleration PEFM .% UI 'MPPS "DDF MFSBUJPO *O J U JB M '& .PEFM .FBTV S F E .PEFM 6 QEBUF E ' & .'SFRVF ODZ)[

문장표절률: **0%**

(e) Transfer function of HMD to 5th floor acceleration Figure 3.22: The transfer f unction comparison of the initial, measured, up- dated FE model.

문장표절률: **0%**

98 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads size of m. The output transfer functions to üb or üh are given by Th = Yh(s)Uh(s) −1 = C (sI−A)−1 Bh + Dh Tb = Yb(s)Ub(s) −1 = C (sI− (3.20)A)−1 Bb where the scalar s is a complex variable jω.

문장표절률: **0%**

The inverse of Th exists only if r equalstom and the Laplace transform of üh provi ding the identical output to the base acceleration induced one is determined as Uh( ) = T −1 h Yh(s) = T −1 h Yb(s) = T −1 h TbUb(s) (3.21) when r is smaller than m, the number of structural responses which can be modulated by üh is restricted t o r and targetstructural responseshould be selected.

문장표절률: **0%**

The Laplace transform of input realizing the target response ȳ with size of r is Ūh(s) = T̄ −1 h Ȳh(s) = T̄ −1 h Ȳb(s) = T̄ −1 h T̄bŪb(s) (3.22) where, T̄−1h is a sub-matrices of T −1 h .

문장표절률: **0%**

T̄ −1 h is constructed by extracting the columns in T−1h corresponding to the targ et response. Design of HMD controller The excitation force is generated by the H MD to vibrate the structure in the elastic range.

문장표절률: **0%**

In order to control the HMD, the linear oscillating ac- tuator (LOA) using electro magnetic force as an exciter was adopted. The mass of HMD is 1,500kg mass mo unted in the 5th floor of the structure.

문장표절률: **0%**

The excitation force is generated by not the HMD acceleration of input voltage si gnal but 5th-floor absolute acceleration.

문장표절률: **0%**

Therefore, in order to compensate the distortion of the actual HMD acceleration a gainst the HMD dynamics existing between the reference signal and the actual me asured acceleration of the HMD, the inverse transfer function of the actual acceler ation of HMD with respect to the commandsignal generated by the control compu ter is constructed and implemented in the HMD control computer as shown in Fig ure 3.24.

문장표절률: **0%**

First, the inverse transfer function, of which amplitude and phase are represented i n Figure 3.25 by the dashed line, is obtained experi- mentally.

문장표절률: **0%**

Then, the experimental inverse transfer function is approximated by a rational fun ction for its implementation in the control computer.

출처표시 문장 문장표절률: **0%**

In this verification experiment, the inverse transfer function of the HMD is approximated using the command invfreqs in MATLAB(Coleman et al., 1999), which adopts the damped Gauss-Newton method for iterative search to minimize the sum of the squared error between the measured and the desired frequency response points(Dennis Jr and Schnabel, 1983).

문장표절률: **0%**

The ap- proximation result is given by the following linear filter and compared with the experimental one in Figure 3.25. 99 Chapter.

문장표절률: **0%**

3. Design of Excitation System for Simulating Dynamic Loads Figure 3.23: Photograph of the HMD installed in 5th floor. Control computer Reference signal csiognntarlo, l a (t) r c(t) HMD AcceHleMraH (s) Dt, ion ofa(t) he (a) Definition of the transfer function of the HMD Control computer Reference signal a (t) r HMD csiognntarlo, l −1H (t) hn c(t) HMD AcceHleH (s) MraDti, on ofa(t) he (b) Compensation the dynamics of HMD using the inverse transfer func- tion Figure 3.24: Schematic diagram of the HMD controller.

문장표절률: **0%**

3.2.6 Experimental results Pseudo-earthquake excitation result The pseudo-earthquake forced vibration testing isimplemented.

문장표절률: **0%**

The earth- quake El Centro(1940, NS) and Hachinohe(1968, NS) earthquake accelera- tion which PGAs were scaled down to 0.05g for the safety limit device were used in this study.

문장표절률: **0%**

The pseudo-earthquake excitation signal was generated by the inverse transfer function of structure introduced in the chapter 3.2.5 corresponding to the target responses and the excitation wasimplemented through the HMD controller introduced in the chapter 3.2.5.

인용포함 문장 문장표절률: **0%**

100 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads &"Y QQQFSPSJYNJNFOBUUBJPM O5' .BHOJUVEF ' SFRVFODZ) [(a) Magnitude ' S FRVFODZ) [(b) Phase Figure 3.25: Comparison of the measured and the approximated inverse transfer function of the HMD. Figure 3.27 compares the result in time history of El Centro earthquake response in the analysis and experimental models. It is observed that both results from FE model and experimental one coincides well each other in the initial time range, but the phase in post time rangeshows a tendency to be changed over 90 degrees. It is caused that the constraint in curve fitting the transfer function was considered weightily with the amplitude of the response, not the phasesince in the seismic performance of the structure the amplitude was laid more weight on than the phase. Figure 3.28 compares the result in the frequency domain of El Centro earthquake response in analysis model and experimental one. It is observed that both of results from FE model and experimental one coincides well each other, respectively Figure 3.29 compares the result in the time domain of Hachinohe earth- quake response in analysis model and experimental one. It is observed that both of results from FE model and experimental one are good agreement and demonstrate the effectiveness proposed pseudo-earthquake forced vibration testing method. The discrepancy in amplitude at the second mode frequency is caused by the difficulty of excitation a structure to higher modes limits the modal testing method to capturing only a few lower modes. In order to 101 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads QMFFSSBJUNJPFOO UBM FD) 3F .GF%S F"ODDDFFM F"SOBUBJMPZOUJ D3BFMT)QP. O%T F" D &DYF

인용포함 문장 문장표절률: **0%**

5JNF T FDPOE (a) Acceleration of HMD excited by El Centro earthquake QMFFSSBJNUJPFOO UBM)3F.GF%S F"ODDDFFM F"SOBUBJMPZOUJ D3BFMT)QP.O%T F" D &DYF 5JNF T FDPOE (b) Acceleration of HMD excited by Hachinohe earthquake Figure 3.26: Comparison of the reference and measured acceleration time histories when the signals were generated by El Centro and Hachinohe earth- quake. &)B.SU%I JROVEBVLDFF JEO E&VYDQFFES J N"OFBOMUZ TJT "DDFMFSBUJPO N TFD "

인용포함 문장 문장표절률: **0%**

DDFMFSBUJPO N TFD &)B.SU%I JROVEBVLDFF JEO E&VYDQFFES J N"OFBOMUZ TJT 5JNF T FDPOE 5JNF T FDPOE (a) 1st floor acceleration of El Centro (b) 2nd floor acceleration of El Centro earthquake excitation earthquake excitation &)B.SU % I JROVEBVLDFF JEO E&VYDQFFES J N"OFBOMUZ TJT "DDFMFSBUJPO N TFD "

인용포함 문장 문장표절률: **0%**

DDFMFSBUJPO N TFD &)B.SU%I JROVEBVLDFF JEO E&VYDQFFES J N"OFBOMUZ TJT 5JNF T FDPOE 5JNF T FDPOE (c) 3rd floor acceleration of El Centro (d) 4th floor acceleration of El Centro earthquake excitation earthquake excitati on &)B.SU%I JROVEBVLDFF JEO E&VYDQFFES "OBMZTJT JNFOU "DDFMF SBUJPO N TFD %JTQMBDFNFOU NN &)B.SU%I JROVEBVLDFF JEO E&VY DQFFES J N"

문장표절률: **0%**

OFBOMUZ TJT 5JNF T FDPOE 5JNF T FDPOE (e) 5th floor acceleration of El Centro (f) 1st floor displacement of El Centro earthquake excitation earthquake excitation Figure 3.27: Time history comparison of El Centro earthquake response in the analysis and experimental models.

문장표절률: **0%**

(when the target response is the 5th- floor acceleration). 102 Dynamic Loads hapter. 3. Design of Excitation System for Simulating &'&YQ NFSPJENFFM OCUBBTMF) F.Y%DJ UFBYUDJPJUOBUJPO & '& YQ NFSPJENFFM OCUBBTMF) F.Y%DJ UFBYUDJPJUOBUJPO .BHOJUVEF 'S FRVFODZ) ['S FRVFODZ)[(a) 1st floor acceleration response (b) 2nd floor acceleration response &'&YQ NFSPJENFFM OCUBBTMF) F.Y%DJ UFBYUDJPJUOBUJPO '& NPEFM CBTF FYDJUBUJPO .BHOJUVEF 'SFRVFODZ) ['S FRVFODZ)[(c) 3rd floor acceleration response (d) 4th floor acceleration response &'&YQ NFSPJENFFM OCUBBTMF) F.Y%DJ UFBYUDJPJUOBUJPO &YQFSJNFOUBM).% FYDJU '& NPEFM CBTF FYDJUBUJPO BUJPO .BHOJUVEF 'S FRVFODZ) ['S FRVFODZ) [(e) 5th floor acceleration response (f) 1st floor displacement response Figure 3.28: Comparison in frequency domain of El Centro earthquake re- sponse of the analysis and experimental models.

문장표절률: **0%**

(when the target response is the 5th floor acceleration). improve this phenomenon, it should be designed to be able to excite higher mode which has fundamental frequencies of a structure.

문장표절률: **0%**

Figure 3.30 compares the result in the frequency domain of Hachinohe earthquake response in analysis model and experimental one.

인용포함 문장 문장표절률: **0%**

It is observed that the coincidence of the response at the first mode and second mode 103 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads &)B.SU%I JROVEBVLDFF JEO E&VYDQFFES J N"OFBOMUZ TJT 5JNF T FDPOE 5JNF T FDPOE "DDFMFSBUJPO N TFD "DDFMFSBUJPO N TFD &)B.SU%I JROVEBVLDFF JEO E&VYDQFFES J N"

인용포함 문장 문장표절률: **0%**

OFBOMUZ TJT (a) 1st floor acceleration of Hachinohe (b) 2nd floor acceleration of Hachinohe earthquake excitation earthquake excitation &)B.SU%I JROVEBVLDFF JEO E&VYDQFFES J N"OFBOMUZ TJT 5JNF T FDPOE 5JNF T FDPOE "DDFMFSBUJPO N TFD "DDFMFSBUJPO N TFD &)B.SU%I JROVEBVLDFF JEO E&VYDQFFES J N"

인용포함 문장 문장표절률: **0%**

OFBOMUZ TJT (c) 3rd floor acceleration of Hachinohe (d) 4th floor acceleration of Hachinohe earthquake excitation earthquake excitation &)B.SU%I JROVEBVLDFF JEO E&VYDQFFES J N"OFBOMUZ TJT 5JNF T FDPOE 5JNF T FDPOE "DDFMFSBUJPO N TFD

문장표절률: **29%**

%JTQMBDFNFOU NN &)B.SU%I JROVEBVLDFF JEO E&VYDQFFES J N"OFBOMUZ TJT (e) 5th floor acceleration of Hachinohe (f) 1st floor displacement of Hachinohe earthquake excitation earthquake excitation Figure 3.29: Time history comparison of Hachinohe earthquake response in the analysis and experimental models.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

Time history comparison of Hachinohe earthquake response in the analysis and experimental models, (when the target response is the 5th floor acceleration) Fig.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Time history comparison of Hachinohe earthquake response in the analysis and experimental models, (when the target response is the 5th floor acceleration) Fig.

문장표절률: **54%**

(when the target response is the 5th-floor acceleration). frequency was shown, but it would not reflect the responses at the third mode or higher mode frequency in Figures 3.30(a)-3.30(c).

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

6.15 comparesthe result in frequency domain of Hachinohe earthquake response in analysis model and experimental one. It is observed that the coincidence of the response at the first mode and second mode frequency was shown, but it would not reflect the responses at the third mode or higher mode frequency in Figs.6.15 (a)-(

c) 104 6.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

6.15 comparesthe result in frequency domain of Hachinohe earthquake response in analysis model and experimental one. It is observed that the coincidence of the response at the first mode and second mode frequency was shown, blit it would not reflect the responses at the third mode or higher mode frequency in Figs.6.15 (a)-(c) 104 6.

문장표절률: **88%**

3.2.7 Error Analysis The normalized RMS error between the absolute acceleration induced by HMD and the base acceleration could be express as Eq.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

FORCED VIBRATION TEST OF REAL-SCALE FIVE STORY STRUCTURE 6.6.2 Error Analysis The normalized RMS error between the absolute acceleration induced by HMD and the base acceleration could be express as Eq.(6.13).

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

FORCED VIBRATION TEST OF REAL-SCALE FIVE STORY STRUCTURE 6.6.2 Error Analysis The normalized RMS error between the absolute acceleration induced by HMD and the base acceleration could be express as Eq.(6-13).

문장표절률: **89%**

(3.23). Figure 3.31 is shown the floor distribute errors corresponding to the target responses of the analysis FE model. All responses are contained 10-20% error values and the minimal error value presented when the target response consider the 5th-floor acceleration.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Fig. 6.16 is shown the floor distribute errors corresponding to the target responses of the analysis FE modeL All responses are contained 10 20% error values and the minimal error value presented when the target response consider the 5th floor acceleration.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

Fig. 6.16 is shown the floor distribute errors corresponding to the target responses of the analysis FE model. All responses are contained 10~그00/o error values and the minimal error value presented when the target response consider the 5th floor acceleration.

문장표절률: **36%**

Σ √ }√Tt=0 ÿΣg(t)2Normalized RMS Error(%) = {√- ΣT t=0 ÿh(t) 2 T 2 t=0 ÿg(t) (3.23) where ÿg, ÿh are the structural acceleration responses which are the base acceleration and the HMD acceleration induced.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

where yh are the structural acceleration responses which are the base acceleration and the HMD acceleration induced. T is total excitation time of the earthquakes.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

where)상, yh are the structural acceleration responses which are the base acceleration and the HMD acceleration induced.

문장표절률: **0%**

T is total excitation time of the earthquakes. Figure 3.32 shows the floor distribute errors of the experimentally mea- sured response corresponding to the target responses.

문장표절률: **0%**

All responses are con- tained 20-30% error values when the HMD induced. 104 g Dynamic Loads hapter. 3. Design of Excitation System for Simulatin &'&YQ NFSPJENFFM OCUBBTMF) F.Y%DJ UFBYUDJPJUOBUJPO '& NPEFM CBTF FYDJUBUJPO .BHOJUVEF 'S FRVFODZ) ['S FRVFODZ)[(a) 1st floor acceleration response (b) 2nd floor acceleration response &'&YQ NFSPJENFFM OCUBBTMF) F.Y%DJ UFBYUDJPJUOBUJPO &'&YQ NFSPJENFFM OCUBBTMF) F.Y%DJ UFBYUDJPJUOBUJPO .BHOJUVEF 'S FRVFODZ) ['S FRVFODZ)[(c) 3rd floor acceleration response (d) 4th floor acceleration response &YQFSJNFOUBM). % FYDJUBUJ '& NPEFM CBTF FYDJUBUJPO PO &'&YQ NFSPJENFFM OCUBBTMF) F.Y%DJ UFBYUDJPJUOBUJPO .BHOJUVEF 'S FRVFODZ) ['S FRVFO

DZ)[(e) 5th floor acceleration response (f) 1st floor displacement response Figure 3.30: Comparison in frequency domain of Hachinohe earthquake re- sponse in th e analysis and experimental models.

문장표절률: **0%**

(when the target response is the 5th-floor acceleration). 3.2.8 Summary In this sec tion, field measurement system of a full-scalestructure and ex- citation system we re established and thenforced vibration test was carried out using the HMD to sim ulate seismic load.

문장표절률: **0%**

System identification of the 105 Chapter. 3. Design of Excitation System for Simul ating Dynamic Loads 4UPSZ 4UPSZ UUBSHFU TUUBSHFU OE 4 4UUPPSSZZ U BUB S BS H SH F HF U FU U SE 4UPSZ UUII 44UUPPSSZZ /P S N B M J[F E 3 .

문장표절률: **0%**

4 & SS P S /P S N B M J[F E 3 . 4 & SS P S (a) El Centro (b) Hachinohe Figure 3.31: Normalized RMS error floor distribution of the analysis FE model correspon ding the distributed floor acceleration response.

문장표절률: **0%**

full-scalestructure was carried out through white noise test, and finite el- ement modelis updated. The seismic excitation system was accomplished through inverse transfer functions of structure and HMD by the system identifications.

문장표절률: **0%**

The propriety of seismic excitation system was verified by a comparison between t he seismic numerical analysis results of finite element model and the experimental results of HMD excitation.

문장표절률: **0%**

106 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads 4UPS Z 4UPSZ UUBUB SHFU TU 4UPSZ BSSHHFFUU OE 4UPSZUBSHFU USIE 44UU PPSSZZUBSHFU UI 4UPSZ / P SN BM J[F E 3 .

문장표절률: **0%**

4 &S S P S / P SN BM J[F E 3 . 4 &S S PS (a) El Centro (b) Hachinohe Figure 3. 32: Normalized RMS error floor distribution of the experimental results correspon ding the distributed floor acceleration response.

문장표절률: **0%**

3.3 Forced vibration test of MR Damper-based Semiactive Control Algorithms for Full-scaled Building 3.3.1 Overview In this section, the effectiveness of the MR d amper-based semiactive control systems for seismic protection of a full-scale five -story steel frame buildingstructure is experimentally verified, when some semi-a ctive control algo- rithms such as the clipped-optimal control algorithm (CO), th e maximum energy dissipation algorithm (MEDA), the Lyapunov stability theory based 107 Chapter.

문장표절률: **0%**

3. Design of Excitation System for Simulating Dynamic Loads control algorithm (LYAP) and the neuro-control algorithm are considered.

문장표절률: **0%**

This may be the first experimental investigation of several semi-active con- trol algorithms using a full-scale test structure.

문장표절률: **0%**

In the experiment, two MR dampers are attached between the ground and the first floor. As described in the previous section, the pseudo-earthquake testing method is used to excite the buildingstructure as if it is subjected to earthquake loading.

문장표절률: **0%**

This method uses filters that modify the displacement of the HMD using both tran sfer function in the frequency domain and the least squares approxima- tion in the time domain.

문장표절률: **0%**

All the semi-active control algorithms are evalu- ated under four historical earth quakes (El Centro, Hachinohe, Kobe, and Northridge earthquakes) and one filtere d artificial earthquake.

문장표절률: **0%**

The experi- mental results are compared with the passive optimal case which pro vides the specific constant voltage to the MR damper.

문장표절률: **0%**

3.3.2 Full scaled MR Damper Lee et al. (2010) had developed full-scale MR dam per, an MR damper is de- signed by deriving a suboptimal design procedure cons idering optimization problem and magnetic analysis, and a damper with the capa city of 1.0ton is manufactured.

문장표절률: **0%**

Table 3.6: Results obtained from the magnetic analysis. No. of stage 3 Flux densit y in < 1.5T steel Magnetic field < 150 kAmp/m intensity Coil turns 20AWG/200 t urns Input current 3A 3 4 > 1.5T < 1.5T >150 kAmp/m < 150 kAmp/m 20AWG/2 30 21AWG/200 turns turns 3A 3A In order to use the designed MR dampers in the experiment, two MR dampers are manufactured as shown in Figure 3.33(a) and 3 .33(b) and tested with harmonic dynamic displacements applied by a servo-hydra ulic testing system.

문장표절률: **0%**

The result of variable current tests is shown in Figure 3.33(c). As shown in Figure 3.33(c), the total damper force at design velocity (60mm/s) is about 10kN.

문장표절률: **0%**

Among the total force, the uncontrollable force is about 2kN or more and controll able force approximately 8kN or less. 3.3.3 Semi-active control algorithms Semi -active control algorithms determine the most appropriate voltage to change visc ous characteristics of the MR damper from the structural re- sponse measurement s.

인용포함 문장 문장표절률: **0%**

Since the MR damper force is related to not only 108 Chapter. 3. Design of Excita tion System for Simulating Dynamic Loads (a) Components of full scaled MR (b) Manufactured full scaled MR Damper Damper $(NN)[7BSJBCMF DVSSFOU U FTU .3' ´ ´ ´ ´ 'PSDF L/ " " " "" ´ ´ ´ % JTQM NN ´ ´ ´ "7 FM N N T (c) Varia ble current test Figure 3.33: Manufactured MR damper and test result.

문장표절률: **0%**

command voltage but also the relative velocity and displacement between both en ds of the damper, the MR dampers cannot be directly controlled by the command voltage.

출처표시 문장 문장표절률: **0%**

So far various semi-active control algorithms have been proposed for control of MR dampers (Jansen and Dyke, 2000). In this section, four different control algori thms areconsidered; CO, LYAP, MEDA, and cost function-based SNC.

문장표절률: **0%**

3.3.4 External excitation loads In order to evaluate the performance of the MR da mper-based semi-active control algorithms and passive control system, a suite of historical ground motions that are intended to encompass both moderate events an d severe events is considered as external excitation load.

문장표절률: **0%**

Moreover, a filtered artificial earthquake (Kanai-Tajimi filter) is also adopted to verify the effectiveness of the control algorithms.

문장표절률: **0%**

Each historical ground motion and the artificial earthquake are scaled down in or der to bound HMD by limited maximum displacement for safety.

문장표절률: **0%**

Each ground motions used in this investigation are 109 Chapter. 3. Design of Exci tation System for Simulating Dynamic Loads as follows and the acceleration of H MD and its powerspectral density are shown in Figure 3.34 and 3.35.

문장표절률: **0%**

Moderate events · El Centro : N-S component of the 1940 Imperial valley, Califo rnia earthquake (magnitude 7.1) recorded at Imperial Valley Irrigation Dis-

문장표절률: **0%**

trict substation in El Centro, California, USA (scaled down to 0.303g); · Hachino he : N-S component of the 1968 Takochioki(Hachinohe) earth-

문장표절률: **0%**

quake (magnitude 7.9) recorded at Hachinohe, Japan (scaled down to 0.265g); Se vere events · Kobe : N-S component of the 1995 Hyogo-ken Nanbu(Kobe) earth

–

문장표절률: **0%**

quake (magnitude 7.2) recorded at Kobe Japanese Meteorological Agency (JMA), Kobe, Japan (scaled down to 0.318g); · Northridge : N-S component of the 1994 Northridge earthquake (mag-

문장표절률: **0%**

nitude 6.8) recorded at the Sylmarcounty Hospital parking lot in Syl- mar, California, USA (scaled down to 0.227g); Artificial eartuquake

문장표절률: **0%**

· Kanai-Tajimi filtered artificial earthquake (PGA:0.105g) 3.3.5 Measurement Devices and Feedback Control System Measurement devices used in this experiment are displacement sensors, ac-

문장표절률: **0%**

celerometers, load cells, and a current probe. The displacement sensors are used in measuring the relative displacement between ground and the first floor, which is the displacement of MR damper's both ends.

문장표절률: **0%**

When the MR dampers are installed, two LVDT type potentiometers (Midori America LP- 19FB) are used. To the contrary, two laser displacement sensors (Optex CD4-350D) are used, when the MR dampers are not installed.

문장표절률: **0%**

Each floor's acceleration is measured by five accelerometers (PCB 393A03) and that of LAMD by Kyowa AS-2GB accelerometer. The load cells (CAS load cell LS-2T) measuring the MR damper control force are installed between theMR damper and the first floor.

문장표절률: **0%**

The current probes (Tektronix A622) measuring the current into each MR damper are also installed along the MR damper's power cable.

문장표절률: **0%**

The measured data from the above measurement devices are collected and digitalized through a data acquisitionsystem (NI DAQ-card 6062E).

문장표절률: **0%**

The collected data is selected for each semi-active control algorithm, and 110 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads ´ ´ 1PXFS TQFDUSBM EFOTJUZ 5JN F T 'S F RVFODZ) [(a) Scaled El Centro earthquake ´ 1PXFS TQFDUSBM EFOTJUZ 5JNF T 'S F RVFODZ) [(b) Scaled Hachinohe earthquake ´ ´ 1PXFS TQFDUSBM EFOTJUZ ´ 5JNF T 'S F RVFODZ) [(c) Scaled Kobe earthquake Figure 3.34: Acceleration of HMD and PSD used as external excitation load.

문장표절률: **0%**

finally, determined command voltage is sent to a current generator, which converts the voltage to the corresponding current.

문장표절률: **55%**

Then the MR damper can control the buildingstructure with the generated current. Finally, the MR damper-based semiactive feedback control system, which has 12 inputs and two outputs, can be formed as shown in Figure 3.3.5.

[iiav.org] Unified Semiactive Control System Based on MR Damper for Cable .
..

Then the MR damper is able to control the buildingstructure with the generated current. Finally the MR damper-based semiactive feedback control system, which has 12 inputs and 2 outputs, can be formed as Fig.

문장표절률: **48%**

The CO, as well as the cost function-based SNC algorithm, needs full state or the specific state of the structural system in order to calculate the appropriate desired control force.

[iiav.org] Unified Semiactive Control System Based on MR Damper for Cable .
..

5. The clipped-optimal control algorithm as well as the cost function-based semiactive neuro-control algorithm [5] needs full state or specific state of the structural system in order to calculate the appropriate desired control force.

문장표절률: **77%**

The control implementation requires a lot of sensors, and that would be even impossible. Therefore the Kalman filters as an observer for state estimation is desirable.

[iiav.org] Unified Semiactive Control System Based on MR Damper for Cable .
..

Actually the control implementation requires a large amount of sensors and that would be even impossible. Therefore the Kalman filters as an observer for state estimation is desirable.

문장표절률: **21%**

Consider a controllable and observable system and assume that full state estimation is required. Then 111 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads t ´ ´ ´ 1PXFS TQFDUSBM EFOTJUZ VFODZ)[5JNF T ' SF R (a

[iiav.org] Unified Semiactive Control System Based on MR Damper for Cable .
..

Consider a controllable and observable system and assume that full state estimation is required. Then the main purpose of the general Kalman filter is constructing a

) Scaled Northridge earthquake 1PXFS TQFDUSBM EFOTJUZ ´ 5JNF T 'S F RV FODZ) [(b) Kanai-Tajimi filtered artificial earthquake Figure 3.35: Acceleration of HMD and PSD used as external excitation load.

state estimate xˆ(t) that minimizes the steady-state error covariance which is defined by:] P = lim E([x − xˆ t→∞ x − xˆ]T) .

문장표절률: **23%**

the main purpose of the general Kalman filter is constructing a state estimate x̂(t) that minimizes the steady-sta(te error covarianc)e which is defined by: P = lim [x − x̂] [x− x̂]⟩ (3.24) t→∞E The optimal estimator for the state of interest is the Kalman filter which can be expressed as: x̂ = (A− [{ } [ ] LC⟮) x̂ +]L{B}−] y LD u ŷ C 0 D y = x̂ + x̂ I 0 0 u (3.25) where filter gain L is determined by solving an algebraic Riccati equation.

[iiav.org] Unified Semiactive Control System Based on MR Damper for Cable . ..

(2) 302 4 ICSV15 · 6-10 July 2008 · Daejeon · Korea Fig. 5. MR damper-based semiactive feedback control system The optimal estimator for the state of interest is the Kalman filter which can be expressed as x̂ = (A LC) xˆ + [L ⎡⎨ yˆ⎤ = ⎡C⎤xˆ + ⎡0 ⎣xˆ⎦ ⎬ ⎢⎣ I ⎥⎦ ⎢⎣0 − ⎡y⎤ B LD]⎨ ⎣u⎬⎦ ⎤⎡ .

문장표절률: **71%**

The Kalman filter uses the known input u and the measurements y to generate the output and state estimates, that is, ŷ and x̂.

[iiav.org] Unified Semiactive Control System Based on MR Damper for Cable . ..

(3) D 0 ⎥⎦⎨ y⎤ ⎣u⎦ ⎬ where filter gain L is determined by solving an algebraic Riccati equation. The Kalman filter uses the known inputs u and the measurements y to generate the output and state estimates, that is, ŷ and x̂ .

문장표절률: **0%**

Note that ŷ estimates the true system output without noises. 3.3.6 Testing building model All the stories in this building are 6m in height and are 6 x 6m2 in the plan .

문장표절률: **0%**

In order to investigate the modal characteristics of the building, a 112 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads .PUEFBTMUJOUPH XFS W W Y Y Y-".% Y Y Y EE GG D D $TZPTOUUFSNPM Figure 3.36: MR damper-based semi-active feedback control system.

문장표절률: **0%**

forced vibration test is performed using a hybrid mass damper (HMD) lo- cated on the fourth floor in the previous section. The building is excited by a white-noise signal with frequency components of 0-10 Hz, and the corre- sponding acceleration responses are then measured at each floor.

문장표절률: **0%**

Using these measured acceleration data, transfer functions in the frequency domain are obtained, as shown by the dotted lines in Figure 3.22.

문장표절률: **0%**

Finally, the structural damping and stiffness matricesare identified based on the experimentally obtained transfer functions, as shown by the solid lines in Figure 3.22.

문장표절률: **0%**

The estimated mass and the identified damping and stiffness matricesare given in Eqs. (3.26)-(3.28), respectively, with results of 0.52, 1.76, 2.95, 3.67, and 5.38 Hz for each mode.

문장표절률: **0%**

113 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads 1936 5.5 0 0 0 0 M 5 = 0 0 19365.5 0 0 0 0 0 19365.5 0 kg (3.26) 0 0 0 0 19365 .5 14.184 -5.015 0.084 -0.789 0.101-5.015 14.990 -6.397 0.822 -1.145 C 5 = 0.084 -6.397 15.830 -6.120 -0.925 -0.789 0.822 -6.120 14.065 -6.383 kN · s/m (3.27) 0.101 -1.145 -0.925 -6.383 9.750 7473.953 4860.497 1295.606 -908.262 432.162-4860.497 9640.722 -6637.235 2446.225 -926.951 K 5 = 1295.606 -6637.235 10861.354 -6005.863 748.607 -908.262 2446.225 -6005.863 9132.066 -4852.783 kNm 432.162 -926.951 748.607 -4852.783 4543.854 (3.28) 3.3.7 Experimental results The passive control cases which providespecific constant voltage or current to the MR damper are the simplest means to operate the semiactive con- trol using MR damper, because they need neither control algorithms nor measuring sensors.

문장표절률: **0%**

In this paper, therefore, the passive optimal case is de- termined by a series of passively controlled experiments and compared with the performance of the othersemi-active control algorithms.

문장표절률: **0%**

Optimal Passive Case As described above, passive control cases providespecific constant voltage or current to the MR damper.

문장표절률: **0%**

A passive-off case means a case of which voltage is always set to zero, and a passive-on case sets the voltage to the maximum level.

문장표절률: **0%**

Since the maximum current level of the manufactured MR damper used in the exp eriments is 3.0A, a series of passively controlled tests are conducted as increasing the current level from 0.0A to 3.0A by 0.5A to obtain the passive optimal case.

문장표절률: **0%**

Figures 3.37 and 3.38 show the normalized maximum displacement of the first flo or and the normalized maximum acceleration among all the five floors.

문장표절률: **0%**

It is demonstrated from Figure 3.37 that the performance in the maxi- mum displ acement gets better as the current input is increased.

문장표절률: **0%**

The passive- off case (i.e., 0.0A current input) shows the worst performance. In a ddition, the passive control cases with 1.0 or larger input current show the simi- l ar performance.

문장표절률: **0%**

As seen in Figure 3.38, however, there is no trend in the 114 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads performance of the normalized maximum acceleration.

문장표절률: **0%**

Under the moderate earthquakes and the artificial earthquake, most of the normali zed values in maximum acceleration beneath 1.0 which means that the controlled seismic response might be reduced compared with that of the uncontrolled case.

문장표절률: **0%**

Nevertheless, most of the normalized values in acceleration are larger than 1.0 un der the severe earthquakesuch as Kobe and Northridge earthquake.

문장표절률: **0%**

These results indicate that the MR damper-based passive control system is more s uitable in moderate earthquake region than severe earthquake region for reducing the structural acceleration.

문장표절률: **0%**

From the observation as mentioned above, the passive control case with 1.0A can be considered as the optimal passive case.

문장표절률: **0%**

The results in cases of the passive optimal (1.0A) and passive on (3.0A) cases are compared with those in the cases of the othersemi-active control algorithms.

인용포함 문장 문장표절률: **0%**

/PSNBMJ[FE EJTQMBDFNFOU &)M $FOUSP, BDIJOPIF/P,5P CSUFISJEHF $ VSSFOU J OQVU " Figure 3.37: Normalized maximum displacement of passive c ontrol cases (first floor). /PSNBMJ[FE BDDFMFSBUJPO &)MB $DFIOJOUSPP, PC IF/PSUFISJEHF $ VSSFOU J O QVU " Figure 3.38: Normalized maximum ac celeration of passive control cases.

문장표절률: **0%**

115 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads Semi active Control Cases After the optimal passive case is determined, the full-scale fi ve-story steel frame buildingstructure is excited with previously mentioned extern al ex- citation loads using LAMD and controlled with various semi-active contro l algorithms, such as the clipped optimal control algorithm (CO), the LYAP, theM EDA, and the SNC, using MR dampers.

문장표절률: **0%**

The responses of each con- trol case are measured and summarized in Figures 3.3 9 and 3.40. Figure 3.39 shows thenormalized maximum displacement of the first f loor with various control algorithms and Figure 3.40 shows thenormalized maxim um acceler- ation among all the floors.

문장표절률: **0%**

From the experimental results, one can conclude as follows: The CO shows good performance in reducing both displacement and acceleration.

문장표절률: **0%**

For severe earthquakes and artificial earthquake, however, the performance beco mes slightly worse than that of moderate earthquakes.

문장표절률: **0%**

In order to obtain the better control performance from the CO, it should be designed more appropriately by altering the weighting parameters for the specific purpose of a designer.

문장표절률: **0%**

The Lyapunov algorithm and the SNC algo- rithm reduce the acceleration response well enough, but they cannot show the good performance in reducing displacement.

문장표절률: **0%**

In these cases, the MR dampers generate less control force than in the clipped optimal algorithm case. The Lyapunov algorithm shows the worst performance among five al- gorithms in reducing acceleration under the artificial earthquake, and the SNC has a drawback in reducing displacement under the severe earthquakes.

문장표절률: **0%**

Note that among all the semi-active control algorithms, theMEDA shows the best performance in reducing displacement and the worst performance in reducing acceleration.

문장표절률: **0%**

As theMEDA makes the MR dampers generate larger force, the first floor is almost locked with the ground. This causes a considerable increase of the acceleration response of the first floor.

문장표절률: **0%**

It is shown in some cases that maximum acceleration with the controller is larger than that of the uncontrolled case. It is considered that in the experiments, the unexpected electrical and the external environmental noises are involved in the feedback of measured responses, which deteriorates the acceleration control performance that is sensitive to those noises.

문장표절률: **0%**

The passive optimal and passive-on cases are one of the best control algorithms in reducing displace- ment of the structure except for the performance in reducing acceleration.

문장표절률: **0%**

The inter-story drift between the firstandsecond floors can be larger than the displacement of the first floor when the damper force is quite large.

문장표절률: **0%**

Due to the limitation in measuring displacements, the inter-story drift of the sec- ond floor couldnot be measured. In order to verify the above observation, the inter-story drift of the second floor should be measured in the additional tests.

문장표절률: **0%**

The LYAP and SNC algorithms are appropriate in reducing accelera- tions of the structural system. On the other hand, the passive optimal and passive-on cases and theMEDA show excellent performance in reducing the 116 Chapter.

인용포함 문장 문장표절률: **0%**

3. Design of Excitation System for Simulating Dynamic Loads first-floor displacement. $- . Z0B 4 &% Q" 1 /BP$ 1B0 Q/U &M $FOUSP)BDIJOPIF , PCF /PSUISJEHF ,5 /PSNBMJ[FE NBYJNVN EJTQMBDFNFOU Figure 3.39: Normalized maximum displacement comparison of MR damper- based control systems. $-.Z 0 &B%Q 4/$ " 11BBP0Q/U &M $FOUSP)BDIJOPIF , PCF /PSUISJEHF ,5 /PSNBMJ[FE NBYJNVN BDDFMFSBUJPO Figure 3.40: Normalized maximum acceleration comparison of MR damper- based control systems.

문장표절률: **0%**

Figures 3.41 and 3.42 represent time history responses of displacement at first floor and acceleration at second floor, respectively.

문장표절률: **0%**

As shown in the figures, the structural responses in all the control cases are significantly re- duced compared to the uncontrolled case results.

문장표절률: **0%**

Especially, some semiactive cases such as the neuro-control algorithm show the good performance in the reduction of the acceleration on the second floor, while the passive cases show good performance in the reduction of the displacement on the first floor.

문장표절률: **0%**

3.3.8 Summary The effectiveness of the MR damper-based control systems with various control algorithms for seismic protection of full-scale five-story steel frame buildingstructure is experimentally verified in this investigation.

문장표절률: **0%**

An MR damper is designed by deriving a suboptimal design procedure considering optimization problem and magnetic analysis, and manufactured into 1.0ton MR damper in order to realizesemiactive control systems.

문장표절률: **0%**

In the experi- ments, the pseudo-earthquake testing method is used to excite the building 117 Chapter. 3. Design of Excitation System for Simulating Dynamic Loads

인용포함 문장 문장표절률: **0%**

6$0ODPOU-ZBQ ´ 5 JNF T .4/&$%" ´ 5 JNF T 1 1 BBP0Q/U ´ ´ 5 JNF T Figure 3.41: Time history responses of displacement at the first floor under %JTQMBD the El Centro earthquake. 6 $ O0DPOU-ZBQ ´ ´ DDFMFSBUJPO BU OE PPS N T 5JNF T . 4/ &$%"

인용포함 문장 문장표절률: **0%**

´ ´ 5JNF T 1 1 BBP0Q/U ´ ´ SBUJPO BU OE PPS N T "DD 5JNF T Figure 3.42: Time history responses of acceleration at the second floor under the Kobe earthquake. structure as if it is subjected to earthquake loading. Under the four histor- ical earthquakes and one filtered artificial earthquake, various semi-active control algorithms including the passive optimal case are evaluated and "DDFM 118 Chapter.

문장표절률: **0%**

3. Design of Excitation System for Simulating Dynamic Loads compared with one another. From theseries of passively controlled tests which are conducted as increasing the current level, the passive case with the input current of 1.0A is chosen as the passive optimal system.

문장표절률: **0%**

From the experimental results, one can conclude that LYAP and SNC algorithms are appropriate in reducing accelerations of the structural system, and pas- sive optimal case and MEDA shows excellent performance in reducing the first-floor displacement.

문장표절률: **0%**

119 Chapter 4 Hybrid Testing Method on a Semi-actively Controlled BuildingStructure Equipped with Full-scale MR Dampers In this study, the verification of the hysteretic behavior of an MR damper and the quantitative evaluation of the seismic performance of a buildingstructure installed with an MR damper are carried out experimentally using the hybrid testing method.

출처표시 문장 문장표절률: **0%**

This componentshould be an electronic control unit or a real engine. The interface between simulated and physical com- ponents is achieved through the direct transfer of electrical signals, without actuation devices(Christenson et al., 2008).

문장표절률: **0%**

As described in chapter 2, the hybrid testing method is a structural testing technique, in which the numer- ical integration of the equation of motion of a numerical substructure and the physical testing of an experimental substructure with severe non-linear characteristics are carried out simultaneously in real-time.

문장표절률: **0%**

In chapter 2, it has been performed both experimentally and analytically on the hybrid test- ing technique in order to overcome the difficulties in the testing of large-scalestructures.

문장표절률: **0%**

This technique is especially useful for evaluating the performance of the nonlinear control device itself as well as that of the integrated system incorporated with the nonlinear control devicesuch as MR damper.

문장표절률: **0%**

4.1 Outline of Methodology Figure 4.1 shows the concept of the hybrid testing method, which is exper- imentally implemented in this study.

문장표절률: **0%**

As shown in Figure 4.1(a), the struc- tural response of a building model with n-degrees-of-freedomsubjected to base input motion, $\ddot{x}g(t)$, is controlled by an MR damper, which is typi- cally located in the first story to reduce the maximum shear force of a barestructure.

문장표절률: **0%**

The whole system is divided into experimental and numerical substructures (Figure 4.1(b)). The MR damper is used as an experimental substructure because it is very difficult to numerically predict its exact dy- namic behavior under seismic load, due to its strong non-linear characteristic of the dependency of the damper force on the loading rate and amplitude.

문장표절률: **0%**

121 Chapter. 4. Hybrid Testing Method on a Semi-actively Controlled BuildingStructure Equipped with Full-scale MR Dampers The remaining parts, that is, the structure without an MR damper, are an- alytically calculated.

출처표시 문장 문장표절률: **0%**

As shown in Figure 4.1(c), three procedures including the measurement of force, the numerical calculation of analytical parts, and the loading of the experimental substructure are used to implement the hy- brid testing method for the whole structural control system(Blakeborough et al., 2001).

문장표절률: **0%**

First, the force acting at the interface between experimental and numerical substructures (here, the control force generated by the MR damper), is measured by the load cell attached to an actuator.

문장표절률: **0%**

The value of this measured control force is then returned to the control computer for use in the calculation of the displacement constraint condition, which should be satisfied by both the experimental and numerical substructures.

문장표절률: **0%**

Finally, the MR damper physically tested in the laboratory is loaded by an actuator with respect to the displacement response of the story installed with theMR damper.

문장표절률: **0%**

The numerical substructure surrounded by the dotted line in Figure 4.1(c) is calculated based on the equation of motion for the build- ing model equipped with an MR damper that is subjected to ground input acceleration, which is represented by : $M\ddot{x}(t) + C\dot{x}(t) + Kx(t) = -M\Gamma\ddot{x}g(t) + Hfe(t)$ (4.1) where, M, C, and K represent the nxn structural mass, damping, and stiffness matrices, respectively; x(t) the nx1 vector of the relativestructural displacement to the ground input motion; Γ the nx1 vector of the ground input motion influence coefficients; H the n x 1 vector that represents the location of the MR dampers; ẍg(t) the ground input acceleration; and fe(t) the control force exerted by the MR damper on the structure, in which subscript 'e' represent 'experimentally ' measured control force.

문장표절률: **0%**

To perform the hybrid testing method, Eq. (4.1) is transformed into its state-space representation, which positively specifiestherelationship be- tween the input and output of the numerical substructure and can be written as: ża(t) = Asz(t) + Bsu(t) (4.2) Ys(t) = Csz(t) + Dsu(t) where zs(t) = {x(t), ẋ}} is the 2n x 1 systemstate vector; U(t) = {fe(t), ẍg(t)}} the 2 x 1 system input vector; and Ys(t) = x(t) the n x 1 system output vecor.

문장표절률: **0%**

The 2nx 2n systemstate matrix, As, and the 2nx 2 locaation matrix of system input, Bs, both associated with the systemstate variables, are represented by: [ ] 0 As = nxn I [-M-1K -M-]1C (4.3) 0 B 1s = nx1 0nx -M-1H -Γ 122 Chapter.

문장표절률: **0%**

4. Hybrid Testing Method on a Semi-actively Controlled BuildingStructure Equipped with Full-scale MR Dampers mn Yn(t) mn□1 Yn□1(t)

문장표절률: **0%**

m1 Y1(t) xg(t) mn Yn(t) mn□1 Yn□1(t) m1 Y f(t) 1 (t) f(t) xg(t) (a) structural control system (b) experimental and numerical substructures 'PSDF NFBTVSJOH

인용포함 문장 문장표절률: **0%**

.3 EBNQFS "DUVBUPS f(t) $POUSPM DPNQVUFS mn Yn(t) -PBEJOH n□1 Yn□1(t) m1 x (t) Y1(t)g(t) f $BMDVMBUJOH (c) implementation of hybrid testing method Figure 4.1: Conceptual view of hybrid testing method for a building with an MR damper. and the nx n system out matrix, Cs, and the nx 2 direct transmission matrix, Ds, both related to the system output variables, are given by: Cs = I, Ds = 0nx1 (4.4) In Eqs. (4.3) and (4.4), I is the nx n unit matrix, while 0nxn and 0nx1 are the nx n and nx 1 zero matrices, respectively. Note that, in the actual implementation of hybrid testing method, the system output vector, Ys(t), in Eq. (4.2) should be designated as the story drifts where the MR dampers are installed and Eq. (4.4) should also be modified because these story drifts affect the system output vector. A full-scale five-story steel frame building is considered as the model of the numerical substructure to use in the structural modal testing of this study, as shown in Figure 3.17. When these identified structural properties are incorporated in the nu- 123 Chapter. 4. Hybrid Testing Method on a Semi-actively Controlled BuildingStructure Equipped with Full-scale MR Dampers B C $TVJHSOSFBOM UB$NVSQSMFJ OFUS &TYVQCFTSUJSNVDFUOVUSBFM D 4JHOBM HFOFSBUPS $POTUBOU WPMUBHF $BDVMDSVSFMBOUUFE $ $POUSPM DPNQVUFSGPPOSDUSFPM $POUSPM BMHPSJUIN GPS JNQMFNFOUJOH 35):5&. $PTNJHNOBBMOE $TPJHOOUBSPM M "OBMPH PVUQVU

문장표절률: **0%**

65. DPOTPMF DPNQVUFS Figure 4.2: Schematic view of experimental set-up: (a) building model in- stalled with an MR damper, (b) UTM installed MR damper, and (c) exper- imental instrumentation.

문장표절률: **0%**

merical substructure, Eqs. (4.2), (4.3) and (4.4) can be rewritten as Eqs. (4.5), (4.6) and (4.7), respectively. ża(t) = Anzn(t) + Bnu(t) (4.5) Yn(t) = Cnzn(t) + Dnu(t) where, Zn(t) = {x1(t), ..., x5(t), ẋ1(t), ..., ẋ5(t)}〉 is the 10 x 1 systemstate vector; u(t) = {fe(t), ẍg(t)}〉 the 2 x 1 system input vector; and Yn(t) = {x1(t), ..., x5(t), ẋ1(t), ..., ẋ5(t), ẍ1(t), ..., ẍ5(t)}〉 the 15 x 1 system output vector.

문장표절률: **0%**

The 10x10 systemstate matrix, An, and the 10x2 location matrix of system input, Bn, are represented by Eq. (4.6): An = 5 −M−15 K −M−15 C5 0 B 5x1 05x1 n = −M−15 H5 −Γ5 and the 15x10 system out matrix, C5, and the 15x2 direct transmission 124 Chapter.

문장표절률: **0%**

4. Hybrid Testing Method on a Semi-actively Controlled BuildingStructure Equipped with Full-scale MR Dampers matrix, D5 are given by Eq.

문장표절률: **0%**

(4.7) I 05x5 5 −M−15 K 05x1 −M−15 C5 (4.7) 05x1 n 5x1 5x1 −M−15 H5 −Γ5 In Eq. (4.6) and (4.7), I is the 5 x 5 unit matrix, while 05x5 and 05x1 are the 5x 5 and 5x 1 zero matrices, respectively.

문장표절률: **0%**

4.2 Controller Design Strategy for the Hybrid Test- ing Method 4.2.1 Experimental Set-up In general, the successful experimental implementation of the hybrid testing method with high accuracy depends strongly on the dynamic performance of the actuators used to excite the experimental substructure in the test.

문장표절률: **0%**

Namely, the actuators used in the test should promptly react to applied commandsignals and load the experimental substructure.

문장표절률: **0%**

In this study, a universal testing machine (UTM), which is commonly used for the perfor- mance test of various structural materials, is utilized as an actuator to load the experimental part.

문장표절률: **0%**

Figure 4.3 shows the experimental set-up using UTM with themaximum loading capacity of 200kN and excitation frequency range of 0−10 Hz (Model name STL-HU10T).

문장표절률: **0%**

An MR damper, which can develop a control force ranging from 3 to 12 kN, is connected to this system. As shown in Figure 4.2, in order to perform the hybrid testing method, three appa- ratuses withinterconnected functions are equipped with the experimental set-up.

문장표절률: **0%**

The main task of the signal generator is to generate the current sig- nal, by which an MR damper is operated, and control force is exerted on the UTM.

문장표절률: **0%**

The control computer with a digital signal processing (DSP) board calculates the responses of the numerical substructure using the input (the control force measured from a load cell of the UTM) and sends the com- mand signal to the UTM console computer.

문장표절률: **0%**

The primary task of the UTM console computer is to transfer the command signal generated by the control computer, according to the control algorithm for implem enting the hybrid testing method, to the UTM.

문장표절률: **0%**

Finally, the UTM excites the experimental part according to this control signal. 1 25 Chapter. 4. Hybrid Testing Method on a Semi-actively Controlled BuildingStr ucture Equipped with Full-scale MR Dampers Figure 4.3: Configuration of experi mental system.

문장표절률: **0%**

4.2.2 Controller Design of UTM In order to accurately load the experimental subs tructure by an actuator and in accordance with the control algorithm of the hybrid testing method, the dynamic property of the actuator itself between the command signal and the measured response should be appropriately compensated.

문장표절률: **0%**

Without this compensation, problems can occur with the experimental results such as chattering problems or the operating performance of the testing system can be d egraded.

문장표절률: **0%**

In particular, during structural testing associated with vibration control issues, the control force often acts as an external load, and as a result, the experimental syste m can become unstable.

문장표절률: **0%**

In order to experimentally measure the dynamics of UTM, white noise with a freq uency ranging from 0 to 10Hz is used as the command signal, 126 Chapter.

문장표절률: **0%**

4. Hybrid Testing Method on a Semi-actively Controlled BuildingStructure Equip ped with Full-scale MR Dampers as shown in Figure 4.2 and the corresponding di splacement of UTM that is driven by this signal are then measured.

문장표절률: **0%**

Using these input and output data sets in the time domain, the transfer function in the frequency domain, which corresponds to the dynamics of the UTM itself, is ob tained.

문장표절률: **0%**

The phasedelay is compensated using the inverse transfer function (ITRF; Lee et a l. (2007a, b)), in which the relationship between the input and out- put in the tran sfer function is reversed.

문장표절률: **0%**

Accordingly, the measured ITRF is obtained with the input of the measured displa cement of the UTM and the output of the commandsignal, as shown by the dotted lines in Figure 4.4.

문장표절률: **0%**

This measured ITRF should be incorporated in the control computer as part of the control algorithm shown in Figure 4.2, in order to compensate the phasedelay of t he UTM and to correctly excite the experimental substruc- ture.

출처표시 문장 문장표절률: **0%**

The measured ITRF is approximated using the invfreqs command in MATLAB(Co leman et al., 1999), which finds the real numerator and denom- inator coefficient vectors of the approximated transfer function in the form of a fractional expressio n by adopting the damped Gauss-Newton method for iterative search, which mini mizes the sum of the squared error between the measured and the approximated fr equency response points(Dennis Jr and Schnabel, 1983).

문장표절률: **0%**

The approximation result is shown by the solid line in Figure 4.4 is given by the f ollowing second-order linear analog filter.

문장표절률: **0%**

368.6533 G- 2 1 7.1945s + 636.4862s+ 27(s) = (4.8) s2 + 412.4726s+ 27758.675 6 where the Laplace variable, s, equals jω with the imaginary constant, j.

문장표절률: **0%**

Figure 4.4 shows that, at 5 Hz, compensation on phase lag is attained only by 20 ○ with the approximated ITRF, while the phase lag of 60○ is observed in the me asured ITRF.

문장표절률: **0%**

Further compensation would be possible with the use of other filters. However, fur ther compensation is excluded here since it would have resulted in an unstable IT RF.

문장표절률: **0%**

127 Chapter. 4. Hybrid Testing Method on a Semi-actively Controlled BuildingSt ructure Equipped with Full-scale MR Dampers .FBTVSFE .BHOJUVEF 'SFRVFO DZ)[(a) Magnitude .FBTVSFE $BMDVMBUFE 'SFRVFOD)[(b) Phase Figure 4 .4: Measured and approximated ITRFs from the displacement of UTM to the com mandsignal.

문장표절률: **0%**

Eq.(4.8) is converted into the following statespace realization for imple- mentatio n in the control computer. ys = Aiys(t) + Bir(t) c(t) = Ciys(t) +Dir(t) (4.9) where ys, r(t) and c(t) are the 2 x 1 state vector, the 1 x 1 reference signal, and the 1x1 c ommandsignal of the UTM, respectively; and Ai, Bi, Ci and Di are the 2x2, 2x1, 1x2 and 1x1 system matrices, respectively.

문장표절률: **0%**

4.3 Experimental verification 4.3.1 Integrated Controller of the Numerical Substru cture and UTM The numerical substructure and the approximated ITRF explained above are incorporated into the control computer as an integrated controller to im plement the hybrid testing method, as shown by the shaded area in Fig- ure 4.5.

문장표절률: **0%**

First, when the constant current sent from the signal generator for the passive cont rol test and the calculated current of semi-active control algorithms sent from the analog output for the semi-active control test are applied to the MR damper, the control force proportional to the magnitude of the current signal is developed and transferred to the UTM.

문장표절률: **0%**

The drift response, x1(t), of the first story where the MR damper is positioned, is 128 Chapter. 4. Hybrid Testing Method on a Semi-actively Controlled BuildingSt ructure Equipped with Full-scale MR Dampers then calculated from the numerica l substructure, given by Eq.

문장표절률: **0%**

(4.5), with two inputs: the control force, fe(t), measured from the load cell attache d to the UTM and the ground input acceleration, ẍg(t) given by the user.

문장표절률: **0%**

Themotion of the UTM is driven by the controller using the ITRF, represented by Eq (4.9) so that the UTM itself operates as the first story where the MR damper is located and excites the MR damper that should be physically tested.

출처표시 문장 문장표절률: **0%**

In the actual experimental implementation of hybrid testing method, the continuou s filters shown in Figure 4.5 are converted into discrete filters with a time interval of 0.01s, while MATLAB Simulink(Simulink, 2009) andReal-Time Windows Tar get(Target, 2009) are used as the control system.

문장표절률: **0%**

4.3.2 Experimental Verification for Simple Bouc-Wen Model The hybrid testing method with a sinusoidal wave excitation is carried out to investigate the hystereti c behavior of the MR damper and to verify the hybrid testing method experimenta lly implemented in this study.

문장표절률: **0%**

A current of 0 A is applied to the MR damper and a sine wave with a frequency of 0.52 Hz, which corresponds to the fundamental frequency of the numerical substru cture, and with an amplitude of 5m/s2 is used as the ground input acceleration as shown in Figure 4.5.

문장표절률: **0%**

$VSSFOU TJHOBM $ $POU E VSJSWSFFOS U ContrSoPl Mc DoPmNpQutVeU rFS $POUSPM BMHPSJUIN vi = S (fe, n) 'VMM TUBUF GFFE CBDL 'PSDF NFB TVSJOH $GPPOSDUFSPM-PBE DFMM BD(DSFPMVFSOBEU JJPOOQ V U n = Anzn(t) +Bnu(t)xg(t) EB.N3Q FS TU T UPSZ ESJGU x *53'1 ( ) ys= Aiys(t) +Bir(t) c(t) = Ciys(t) +Dir(t) $PNNBOE TJHOBM $POUSPM TJHOBM 65.

문장표절률: **0%**

BDUVBUPS 6UT5M. sTyZsTteUFmN "OBMPH PVUQVU 6UT5M. cDoPnOsToPl eMF c oDmPNpuQtVerUFS Figure 4.5: Integrated controller for implementing the hybrid testing method.

문장표절률: 0%

Parametric identification is then performed to find the numerical model of the MR damper on the basis of the experimentally measured hysteretic 129 Chapter.

출처표시 문장 문장표절률: 0%

4. Hybrid Testing Method on a Semi-actively Controlled BuildingStructure Equipped with Full-scale MR Dampers loop. The Bouc-Wen modelis widely used for modeling various hysteretic loops(Wen, 1976).

문장표절률: 0%

The control force by the MR damper canalso be specified using this model. The forcedescribed by this modelis represented by: fMR(t) = αz(t) + cMRẋ1(t) + kMRx1(t) + f0 (4.10) where, kMR and cMR are the stiffness and viscosity of the MR damper; f0 the initial friction force; z a dimensionless valuable introduced to describe the hysteresis; and α a variable that regulates the effect of z on fMR(t) which depends on the magnetic field; z is given by the following differential equation.

문장표절률: 0%

ż(t) = −γ|ẋ1(t)|z(t)|z(t)|n−1 − βẋ1(t)|z(t)|n +Aẋ1(t) (4.11) where γ, β, A and the superscript n are the coefficients determining the shape of the hysteretic curve.

문장표절률: 0%

The eight parameters in Eqs. (4.10) and (4.11) (α, cMR, kMR, f0, γ, n, β and A) are identified usingleast-squares optimization to minimize the performance index defined as: ΣN J (p) = [fe (k ·△T)− fMR (p, k ·△t)]2 (4.12) k=1 where fe (k ·△t) represents the forcedata measured at the k-th sam- pling time; p the 1x8 vector of the identification parameter, {α, cMR, kMR, f0, γ, n, β, A}; and fMR (p, k ·△t) the force obtained at the k-th calculating time from Eq.

출처표시 문장 문장표절률: 0%

(4.10) and (4.11) using the parameter p. This procedure is carried out using MATLAB subroutines(Coleman et al., 1999), and the identified parameters are given by: α = 13288.130(N/m), cMR = 81418.582(N · s/m), kMR = 16647.456(N/m), f0 = 6.10(N), (4.13) n = 3.0581, γ = 471409.377(m−n), β = 335518.804(m−n), A = 497.295 A comparison between the calculated and experimental responses is provided in Figure 4.6.

문장표절률: 0%

The displacement and velocity in Figures 4.6(b) and 4.6(c) correspond to the first-story drift and velocity responses, re- spectively.

문장표절률: 0%

The Bouc-Wen model represents the force-displacement and the force-velocity hysteretic behaviors of the damper well. 130 Chapter.

문장표절률: 0%

4. Hybrid Testing Method on a Semi-actively Controlle Structure Equipped with Full-scale MR Dampers &$YBQMDFVSMJBNUJFPOOU 5JNF TFD (a) time history of force &$YBQMDFVSMJBNUJFPOOU &$YBQMDFVSMJBNUJFPOOU 'PSDF / TU TUPSZ ESJGU N T U T UP SZ WF MPDJUZ N T FD (b) force-displacement relation (c) force-velocity relation Figure 4.6: Comparison between calculated and experimentally measured responses for the Bouc-Wen model.

문장표절률: 0%

The hybrid testing method implemented in this study is verified by the experiment using the excitation of historical seismic measurements.

문장표절률: 0%

Four different records of earthquake acceleration measurements taken at El Cen- tro, Hachinohe, Kobe, and Northridge are used as ground input acceleration in Figure 4.5 by multiplying them by 0.05.

문장표절률: 0%

Also, the current of 0 [A] is ap- plied to an MR damper in the same manner as the sinusoidal excitation test above. In addition to the measurement of the control force produced by an MR damper, given by Eqs.

문장표절률: 0%

(4.5)-(4.7), the structural displacement, velocity, and absolute acceleration responses are obtained from the hybrid testing method for earthquake excitations.

문장표절률: 0%

Figures 4.7 and 4.8 show a comparison of the responses measured by hybrid testin g method, as shown in Figure 4.5, with those calculated from the five-story building model installed with an MR damper with the identified parameters such as in Eq.

문장표절률: **0%**

(4.13), in order to compute the control force. 131 Chapter. 4. Hybrid Testing Method on a Semi-actively Controlled BuildingStructure Equipped with Full-scale MR Dampers &$YBQMDFVSMJBNUJFPOOU Z N T ´ ´ ´ ´´ 5JNF T (a) absolute acceleration responses QMDFVSMJBNUJFPOOU ´´ $B ´ ´ ´ ´ 5JNF T (b) displacement responses Figure 4.7: Comparison between calculated and experimentally measured responses under El Centro earthquake excitation.

문장표절률: **0%**

In addition, the measured and calculated hysteretic behaviors, shown in Figures 4.9 and 4.10, are compared for different seismic excitations.

문장표절률: **0%**

Fig- ures 4.7 and 4.8 show that the two results agree well with each other. Fig- ures 4.9 and 4.10 show that the Bouc-Wen modelsuccessfully predicted the overall hysteretic behaviors.

문장표절률: **0%**

In particular, the Bouc-Wen modelsuccessfully predicted the hysteretic behavior of an MR damper under the excitation 132 Chapter.

문장표절률: **0%**

4. Hybrid Testing Method on a Semi-actively Controlled BuildingStructure Equipped with Full-scale MR Dampers of the seismic measurements of a narrow frequency band, such as those of the Kobe and Northridge earthquakes corresponding to the representative examples of near-fault source ground motion.

문장표절률: **0%**

133 Chapter. 4. Hybrid Testing Method on a Semi-actively Controlled BuildingStructure Equipped with Full-scale MR Dampers B &$YBQMDFVSMJBNUJFPOOU TU TUPSZ N T ´ ´ ´ ´ 5JN F T (a) absolute acceleration responses &$YBQMDFVSMJBNUJFPOOU ´ ´ ´ ´ 5JN F T (b) displacement responses Figure 4.8: Comparison between calculated and experimentally measured responses under Northridge earthquake excitation.

문장표절률: **0%**

134 Chapter. 4. Hybrid Testing Method on a Semi-actively Controlled BuildingStructure Equipped with Full-scale MR Dampers ´ ´ ´ ´ 'PSDF / ´ ´ ´ ´ ´ ´ TU ´T U P SZ E SJGU N Y ´ ´ ´ ´ $BMDVMBUJPO TU TU PSZ WFMP D J UZ N T (a) force-displacement relation (b) force-velocity relation Figure 4.9: Comparison between calculated and experimentally measured hysteresis under El Centro earthquake excitation.

문장표절률: **0%**

& $ &YBQMDFVSMJBNUJFPOOU $ YBQMDFVSMJBNUJFPOOU ´ ´ ´ ´ 'PSDF / 'PSDF / ´ ´ ´ TU ´ TUPSZ E SJ G U N ´ ´ ´ ´ T U T´U P S Z W FMPD JU Z N T (a) force-displacement relation (b) force-velocity relation Figure 4.10: Comparison between calculated and experimentally measured hysteresis under Northridge earthquake excitation.

문장표절률: **0%**

4.3.3 Applied Semi-active Control Algorithms OPTIMIZATION OF BOUC-WEN PARAMETER BY INPUT CURRENTS In order to compare the results of the numerical analysis with the results of the semi-active hybrid testing method, the identification of the Bouc- Wen parameter corresponding to input currents is required.

문장표절률: **0%**

In this study, a sinewave excitation test isimplemented, and Bouc-Wen parameters (α, A, cMR) are identified. Figure 4.11 shows a comparison between the test model and the iden- tified Bouc-Wen model with respect to different input currents.

문장표절률: **0%**

The opti- mal parameter of the Bouc-Wen modelis established by force-velocity and force-displacement relationships, as shown in Figure 4.11(a) and 4.11(b).

문장표절률: **0%**

135 Chapter. 4. Hybrid Testing Method on a Semi-actively Controlled BuildingStructure Equipped with Full-scale MR Dampers For implementing the semi-active control of an MR damper, three parame- ters which are assumed to be polynomial, exponential functions of the input current are identified using the least square method.

문장표절률: **0%**

Figures 4.11(c)–4.11(e) show the results of each parameter identified and tested. Y IVZNTJFDSBJDM BNM PNEPFEMFM /VNFSJDBM NPEFM " 1/ " " " ´ "´ ´ " ´ "" ´ .3 EBNQFS GPSDF / ´ ´ ´ ´ ´ ´ 4USPLF N ´ ´ ´ ´ 7´F MP D JUZ N T (a) force–displacement relation (b) force–velocity relation 0 Y $VQSU W JNF J[UBU UFJEP OSF QTBVSMBUNFUFS 0QUJ $VSWNF J[UBUUFJEP OSF QTBVSMBU NFUFS %BNQJOH DPF DJFOU PG .3 EBNQFS / T N Y 0$QVUJSNWFJ [BUU UJFPEO SQFBTSVBMNU FUFS $VSS F O U " $VSS F O U " %B $VSS F O U " (c) shape parameter (d) damping coefficient of an (e) shape parameter α MR damp er Figure 4.11: Identified Bouc–Wen parameters and the numerical model of an MR damper.

문장표절률: **0%**

α = −324576.03 exp(−0.85x) + 354777.40 (4.14) cMR = −44567.17 exp(−1.4x) + 60330.96 (4.15) A = 854.7 exp(−5.476x) + 222.5 exp(−0.3321x) (4.16) where, x is input current (A) Clipped–optimal Control Algorithm In terms of implementat ion, this controlstrategy seems to be the most direct because it can take advantage of the significant number of experimental and practical studies that have been con ducted on active controlstrategies.

문장표절률: **0%**

The clipped–optimal algorithm that has been shown to be effective for use with 13 6 Chapter. 4. Hybrid Testing Method on a Semi–actively Controlled BuildingStru cture Equipped with Full–scale MR Dampers the MR damper has been proposed b y Dyke et al.

문장표절률: **0%**

(1996). The clipped– optimal control approach involves designing a linear optim al controller Kc(s) that calculates a vector of desired control forces fc = {fc1 , fc2 , ..., fcn}〉 based on the measured structural responses y and the measured control f orce vector f applied to the stru{cture, that is, } f −1c = L −Kc(s)L{y, f}〉 (4.17) wh ere, L{·} is the Laplace transform.

문장표절률: **0%**

Because the force generated in the MR damper is dependent on the local responses of the structural system, the desired optimal control force fci cannot always be pro duced by the MR damper.

문장표절률: **0%**

Only the control voltage vi can be directly controlled to increase or decrease the f orce produced by the device. Thus, a force feedback loop is incorporated to induce the MR damper to approximately generate the desired optimal control force fci .

문장표절률: **0%**

To induce the MR damper to approximately generate the correspond– ing desired optimal control force fci , the command signal vi is selected as follows.

문장표절률: **0%**

When the i–th MR damper is providing the desired optimal force, the voltage app lied to the damper should remain at the present level.

문장표절률: **0%**

If the magnitude of the force produced by the damper is smaller than the mag– nit ude of the desired optimal force and the two forces have the same sign, the voltag e applied to the current driver is increased to the maximum levelso that the force produced by the damper is increased to match the desired control force.

문장표절률: **0%**

Otherwise, the commanded voltage is set to zero. The algo– rithm for selecting th e command signal for the i–th MR damper is stated as Eq.

출처표시 문장 문장표절률: **0%**

(4.18)(Jansen and Dyke, 2000). vi = VmaxH ({fci − fi} fi) (4.18) Although a varie ty of approaches may be used to design the optimal controller, linear quadratic re gulator (LQR) methods are advocated because of their successful application.

문장표절률: **0%**

The optimal gain of a state vector based on the target building model with MR da mper is used as follows: Kc = [− 98301479.1, 110902868.9, − 36659599.6, 24569 454, 5,−12841877.0, − 4926535.9,−3813412.5,−331115.5, − 1239172.8,−130915 5.8] For implementing the hybrid testing method experiment, the integrated MAT LAB Simulink controller is designed as shown in Figure 4.12.

문장표절률: **0%**

In the field testing application of this control law, it is required that a full struc– t ural state vector is obtained using a filter estimation methodsuch as Ob– 137 Cha pter.

문장표절률: **0%**

4. Hybrid Testing Method on a Semi-actively Controlled BuildingStructure Equipped with Full-scale MR Dampers server/Kalman.

인용포함 문장 문장표절률: **0%**

However, because the hybrid testing method uses the struc- tural model as a numerical model, this method has the advantage that the structural state variable is easily used in the experiment. "*OOBQMVPUH *O 0VU 6 6 & , YZ O O $ "

인용포함 문장 문장표절률: **0%**

Y YO O % #VV O O ' %JTQ %/"B2U$JPBOSBEM JO T U SV& N〈BFVOUUPT〉 %"2 4VCTZTUFN %BNQFS GPSDF *OWFSTF USBOTGFS GVODUJPO %JTQ DPF DJFOU "OBMPH 6 & UF WBSJBCMF % /"B " 2U O $JP B BO MP SB H EM J POV T U U Q SV V &N U 〈BFVOUUPT〉 LPCF NBU , &BSUIRVBLF &2 HBJO &BSUIRVBLF 6/*40/ NPEBM UFTUJOH UPXFS 4UB (BJO 0VU GD &2 HBJO BM$HMPJQSJQUFIEN Figure 4.12: Clipped-optimal and hybrid testing method integrated con- troller.

문장표절률: **0%**

MODULATED HOMOGENEOUS FRICTION ALGORITHM (MHF) This control strategy is originally developed for a variable-friction damper.

문장표절률: **0%**

In this approach, at every occurrence of local extremes in the deforma- tion of the device, the normal force applied to the frictional interface is updated to a new value.

문장표절률: **0%**

At each local minimum or maximum in the defor- mation, the normal force Ni(t) is chosen to be proportional to the absolute value of the semi-active damper deformation.

출처표시 문장 문장표절률: **0%**

The control law is written as Eq. (4.19)(Inaudi, 1997): Ni(t) = gi|P [△i(t)] | (4.19) where gi is a positive gain and the operator P [·] {as the prior-local-peak } operator is defined as P [△i(t)] = △i(t-s), where s = min x ≥ 0 : △ (t- x) = 0 , defining △ (t- s) as the most recent local extreme in the deformation.

문장표절률: **0%**

Be- cause this algorithm was developed for variable friction devices, the following modifications are needed when applying it to MR dampers.

문장표절률: **0%**

(i) There is often no need to check if the force is greater than thestatic friction because MR dampers have no static friction.

문장표절률: **0%**

(ii) A force feedback loop is used to induce the MR damper to produce approximately the frictional force corresponding to the required normal force.

문장표절률: **0%**

Thus, the goal is to generate a required control force with a magnitude of: fni = μ gi|P [△i(t)] = gni |P [△i(t)] (4.20) where the proportionality constant gni has a unit of stiffness N/mm.

문장표절률: **0%**

138 Chapter. 4. Hybrid Testing Method on a Semi-actively Controlled BuildingStructure Equipped with Full-scale MR Dampers As with the clipped-optimal control law, because the force produced by the MR damper cannot be directly commanded, a force feedback loop is used.

문장표절률: **0%**

The measured force is compared to the desired forcedetermined by Eq. (4.20), and the resulting control law is: vi = VmaxH (fni − |fi|) (4.21) where Vmax is the maximum current value that can be offered for the MR damper.

문장표절률: **0%**

An appropriate choice of gni will maintain the force fni within the oper- ating envelope of each MR damper for the majority of the time, allowing theMR damper forces to approximate the desired force of each device closely.

문장표절률: **0%**

However, the optimal value of gni is dependent on the amplitude of the ground acceleration. In this study, the gni value is chosen as 150 kN/m based on the excitation of three earthquakes.

문장표절률: **0%**

In addition, note that this control law is quite straight forward to imple- ment because it only requires the measurement of the applied force and the relative displacements of the control device.

문장표절률: **0%**

For applying the hybrid testing method experiment, the integrated MAT- LAB Simulink controller is designed as shown in Figure 4.13.

문장표절률: **0%**

0.5 Analog In1 Out1 1/2 input Analog input Damper force National instruments DAQ Subsystem DAMPER FORCEDAQCard-6036E [auto] State variable y(n)=Cx(n)+Du(n) -K- x(n+1)=Ax(n)+Bu(n) Analog Output Disp Coefficient inverse transfer function Analog output National instruments In1 Out1 DAQCard-6036E [auto] |u| -K- U U(E) y(n)=Cx(n)+Du(n) north.mat -K- x(n+1)=Ax(n)+Bu(n) Earthquake Current out subsystem Abs gn 1F Disp Earthquake EQ gain UNISON modal testing tower In1Out1 Abs MHF Subsystem |u| Figure 4.13: MHF and hybrid testing method integrated controller.

문장표절률: **0%**

4.4 Testing Result 4.4.1 Passive Control Performance The hybrid testing method illustrated in Figure 4.5 isimplemented to eval- uate the seismic performance of the passive-controlled MR damper used in this study.

문장표절률: **0%**

Except for the variation of the applied current to the MR damper (in the same manner as that above), four earthquake records are also given as the ground accelerations in Figure 4.5.

문장표절률: **0%**

The tests for the controlled case are carried out by increasing the current applied to the MR damper from 0 to 3 A. As shown in Figure 4.6, the test for the uncontrolled case is per- formed by removing the feedback loop of the control force generated by an MR damper into the control computer.

문장표절률: **0%**

Therefore, the numerical substruc- 139 Chapter. 4. Hybrid Testing Method on a Semi-actively Controlled BuildingStructure Equipped with Full-scale MR Dampers ture is excited only by the ground input acceleration (even though a current of 0 A was applied to the MR damper).

문장표절률: **0%**

Figures 4.14 and 4.15 show comparisons for the selected floors of the time histories of experimentally measured structural displacement responses to the excitation of two earthquake excitations, as the current applied to the MR damper is varied.

문장표절률: **0%**

Significant control effects are observed between the uncontrolled and the passive-off case but are not observed in the other passive-on cases with the increase of the applied current.

문장표절률: **0%**

Y ´ ´ ´ ´ ´ ´ 5 JNF T 5 JNF T 6 O D"POUSPMMFE " "" 5 JNF T Figure 4.14: Experimental results, in the time domain under El Centro earth- quake excitation at different applied currents.

문장표절률: **0%**

140 Chapter. 4. Hybrid Testing Method on a Semi-actively Controlled BuildingStructure Equipped with Full-scale MR Dampers ´ ´ 5JNF T ´ ´ 5JN F T 6 O DPO USPMMFE " " "" ´ 5JN F T Figure 4.15: Experimental results, in the time domain under Northridge earthquake excitation at different applied currents.

문장표절률: **0%**

In addition, the displacement responses in the frequency domain to four earthquake excitations at different applied currents are compared to the first floors, as shown in Figure 4.16.

문장표절률: **0%**

The figures show that the peak in the uncontrolled case appears at 0.52 Hz, corresponding to the fundamental frequency of the numerical substructure under consideration, but the peak is shifted to the vicinity of 0.62 Hz as the applied current increases.

문장표절률: **0%**

This small amount of frequency shifting is due to the stiffening effect of the MR da mper used in this study as the applied current is increased.

문장표절률: **0%**

EJTQ MBU 141 Chapter. 4. Hybrid Testing Method on a Semi-actively Controlle d BuildingStructure Equipped with Full-scale MR Dampers TU 4UPSZ EJTQMB DFNFOU NBHOJUVEF TU 4UPSZ EJTQMBDFNFOU NBHOJUVEF 'S FRVFOD Z) ['S FRVFODZ) [(a) El Centro earthquake (b) Kobe earthquake TU 4UPSZ E JTQMBDFNFOU NBHOJUVEF 6 ODPOUSPMMFE " " "" 'S FRVFODZ) ['S FRV FODZ) [(c) Northridge earthquake (d) Hachinohe Figure 4.16: First-story displ acements in the frequency domain at different applied currents.

문장표절률: **0%**

4.4.2 Semi-active Control Performance Figure 4.17 shows a comparison between numerical and experimental results for the clipped-optimal control under El Centr o earthquake excitation based on identified Bouc-Wen parameters.

문장표절률: **0%**

As shown in Figure 4.17, the experimen- tal and numerical results show different currencies. Moreover, because the peak responses are very important in evaluatin g seismic performance, it is critical to have large differences between the experime ntal and numerical re- sults.

문장표절률: **0%**

These results are due to the nonlinearity of MR dampers which varies in the nume rical model corresponding to frequencies of the piston and non- linear reaction ve locity of input currents.

문장표절률: **0%**

Consequently, these results prove that using the hybrid testing method is more pra ctical in non-linear damper models such as MR dampers.

문장표절률: **0%**

142 Chapter. 4. Hybrid Testing Method on a Semi-actively Controlled BuildingSt ructure Equipped with Full-scale MR Dampers Y ´ 6$ODPOUSPMMFE OVNFSJ DBM$MMJJQQQQFFEE´´00QQUUJJNNBBMM DDPPOOUUSSPPM MMMFF EE O3V5N)5F.SJD FBYMQ FSJNFOUBM NFOU N ´´ ´´ ´ 5 JNF T Figure 4.17 : Comparison of numerical and experimental results under El Centro earthquake e xcitation.

문장표절률: **0%**

Figure 4.18 shows a comparison between the first-floor displacements for the time histories of experimentally measured structural displacement re- sponses to the ex citation of three earthquake excitations, as the current ap- plied to the MR dampe r is varied corresponding to each semi-active control algorithm.

문장표절률: **0%**

Significant control effects are observed between the uncontrolled and the passive c ontrol cases but are not observed in each semi-active con- trol case of El Centro, as shown in Figure 4.18(a).

문장표절률: **0%**

In Figure 4.18(c), the clipped optimal control algorithms show remarkable perfor mances in con- trolling displacement response.

문장표절률: **0%**

143 Chapter. 4. Hybrid Testing Method on a Semi-actively Controlled BuildingSt ructure Equipped with Full-scale MR Dampers .)' TU 'MPPS EJTQMBDFNFOU NN 5JNF T FDPOE (a) El Centro earthquake 5JN F TFDP OE (b) Kobe earthqua ke 5JNF T FDPOE (c) Northridge earthquake Figure 4.18: Passive and semi-acti ve hybrid testing method experimental results(time domain).

문장표절률: **0%**

Also, the displacement responses in the frequency domain to three earth- quake ex citations applied to uncontrolled, passive, and semi-active con- trolled hybrid tes ting method are compared to the first floor, as shown in Figure 4.19.

문장표절률: **0%**

The figures show that an overall best control performance is achieved when the cli pped optimal control algorithms are applied to the structure.

문장표절률: **0%**

However, all the results show insignificant control performance against the passiv e control. These results are influenced by the long-period modelstructure having 0 .52 Hz and a scaled-down excitation load due to the UTM capacity.

문장표절률: **0%**

For the passive result, the peak response is shifted to the TU ' 144 Chapter. 4. Hybrid Testing Method on a Semi-actively Controlled BuildingStructure Equipped with Full-scale MR Dampers vicinity of 0.62 Hz in a semi-active controlled result.

문장표절률: **0%**

This small amount of frequency shifting is due to the stiffening effect of the MR damper used in this study as the applied current is increased for the passive control results.

문장표절률: **0%**

UI "DDFMFSBUJPO NBHOJUVEF 'S FRVFODZ) ['S FRVFODZ) [(a) El Centro earthquake (b) Kobe earthquake 'S FRVFODZ)[(c) Northridge earthquake 61B OTDTPJWOUSPMMFE$.M F DPOUSPM PJQEVQMFBEUF PEQ IUPJNNBPMH FOPVT GSJDUJPO Figure 4.19: Passive and semi-active hybrid testing method experimental results(frequency domain).

문장표절률: **0%**

4.5 Summary In this chapter, the investigation of the hysteretic behavior of an MR damper and the seismic performance evaluation of a buildingstructure, installed with an MR damper, are experimentally implemented using the hybrid test- ing method.

문장표절률: **0%**

In the tests, the building model that is identified from the force-vibration test results of a full-scale five-story building is adopted as a numerical substructure in this study.

문장표절률: **0%**

Also, an MR damper that corresponds to an experimental substructure is physically tested using a UTM. The Bouc- Wen modelis used to calculate the control force of the MR damper used in this study, and its parameters are identified based on the experimental results from the hybrid testing method, which used a sinusoidal wave as the ground input acceleration.

문장표절률: **0%**

The hybrid testing method is validated because 145 Chapter. 4. Hybrid Testing Method on a Semi-actively Controlled BuildingStructure Equipped with Full-scale MR Dampers the hybrid testing results from the sinusoidal and earthquake excitations and the corresponding analytical results agreed well with each other.

문장표절률: **0%**

In particular, the hybrid testing method is highly reliable with the impulse-like seismic excitation such as that of the Northridge earthquake.

문장표절률: **0%**

In order to compare the results obtained from the hybrid testing method and the nu- merical analysis, Bouc-Wen model parameters are identified by each input current.

문장표절률: **0%**

The results of this comparison show that the hybrid testing method is more practical than the numerical analysis due to the non-linear variations of the reaction velocity and excitation frequency.

문장표절률: **0%**

The experimental results from the hybrid testing method for the passive controlshow that struc- tural responses did not decrease further by the excessive control force, but they decreased with the increase of the current applied to the MR damper.

문장표절률: **0%**

In addition, the semi-active controlled resultshows an insignificant control performance compared to the passively controlled result.

문장표절률: **0%**

It seems that the passive control forces of the MR damper already reached the optimal friction force by the proportional shear force of the first floor.

문장표절률: **0%**

146 Chapter 5 Conclusions In this paper, firstly, a substructuring technique, TLD-, TLCD- and TLMD- buildingstructure hybrid testing method for the shaking tabletest was pro- posed.

문장표절률: **0%**

The proposed testing technique adopts the upper part of the whole structure or non linear control devices as the experimental substructure, which corresponds to a ph ysical test model.

문장표절률: **57%**

The lower part of the entire structure or whole buildingstructure is modeled numer ically. In order to verify the validity and accuracy of the proposed technique, a sh aking tabletest was conducted.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

In order to verify the validity and accuracy of the proposed technique, a shaking t abletest was conducted. The result of the study can be summarized as follows.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

In order to verify the validity and accuracy of the proposed technique, a shaking t abletest was conducted. The result of the study can be summarized as follows.

문장표절률: **75%**

The result of the study can be summarized as follows. 1. To reduce the distortion of the interface acceleration, the inverse trans- fer function of the shaking table w as identified, and its statespace realization wasimplemented in the shaking table c ontroller.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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(1 To reduce the distortion of the interface acceleration, the inverse trans fer functi on of the shaking table was identified and its statespace realization wasimplement ed in the shaking table controller.

문장표절률: **66%**

2. In this paper, the linear transfer function approach for controlling themotion of a shaking table was considered to verify the proposed method for a linear experim ental part experimentally.

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저자 : 박은천
발행 : 서울: 檀國大學校, 2006

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문장표절률: **53%**

However, this approach would be inappropriate in a coupled non-linear system le ad- ing to experimental instability. Therefore, in such case, the controller using th e inverse transfer function of shaking table, shown in Fig- ure 2.6, would be modi fied to compensate an experimental instability.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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However, this approafii would be inappropriate for a coupled non-linear system l ead ing to experimental instability. Therefore, in such case the controller using the inverse transfer function of shaking table would be modified to compensate an exp erimental instability.

문장표절률: **95%**

3. The interface force between the experimental and numerical substruc- tures wa s obtained using only acceleration measurement and mass in- formation so that hi gh-capacity loads cell and installation jigs are not required in the substructuring t

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real -time hybrid test method of building structures

저자 : 박은천

echnique.

발행 : 서울 : 단국대학교 대학원, 2007.2

11,would be modified to compensate an experimental instability. (3 The interface force between the experimental and numerical substruc tures was obtained using only acceleration measurement and mass in formation so that high-capacity loads cell and installation jigs are not required in the experiment.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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발행 : 서울: 檀國大學校, 2006

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문장표절률: **73%**

4. The proposed method basing the interface force measurement on accel- eration measurements from an experimental substructure is partially available only when the mass distribution is discrete - for example, this technique would be applicable to the TMD as an experimental part.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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문장표절률: **100%**

Also, the interface force measurement using force transducers is required to perform the proposed method when wind forces are applied to the experimental substructure.

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Also, the interface force measurement using force transducers is required to perform the proposed method when wind forces are applied to the experimental substructure.

문장표절률: **0%**

5. Experimental results demonstrate that the proposed substructuring technique can reproduce the dynamic behavior of the assumed entire structure.

문장표절률: **83%**

147 Chapter. 5. Conclusions 6. An unexpected vibration of the experimental substructure can be induced by the feedback of responses including its inherent natural modes and then by the error occurred in calculating the numerical substructure.

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(6) Unexpected vibration of the experimental substructure can be induced by the feedback of responses including its inherent natural modes and then by the error occurred in calculating the numerical substructure.

문장표절률: **66%**

7. It is considered that to minimize the effect of natural modes of an experimental substructure on the substructured system, the structural model as heavily-damped as possible would be used as an experimental part.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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문장표절률: **73%**

8. The proposed technique can be extended to the substructuring tech- nique with themiddle part of a whole structure in combination with the conventional substructuring technique employing lower part as the experimental substructure.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

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REAL-TIME SUBSTRUCTURING TECHNIQUE possible would be used as an experimental part. (8 The proposed technique can be extended to the real-time substructuring tech nique with themiddle part of a whole structure in combination with the conventional substructuring technique employing lower part as the experimental substructure.

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저자 : 박은천
발행 : 서울: 檀國大學校, 2006

REAL-TIME SUB STRUCTURING TECHNIQUE possible would be used as an experimental part. (8 The proposed technique can be extended to the real-time sub striictiuing tech nique with themiddle part of a whole structure in combination with the conventional substmctiuiiig technique employing lower part as the experimental substructure.

문장표절률: **82%**

9. The TLD installed on the top floor of the structure is physically tested, and simultaneously numerical calculation is carried out for the as- sumed analytical structural model.

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The TLCD installed at the top floor of the structure is physically tested, and simultaneously numerical calculation is carried out for the as sumed analytical structural model.

문장표절률: **26%**

10. Comparison between the structural responses obtained by the hybrid testing method and the conventional shaking tabletest of a single story steel frame with TLD and TLCD indicates that the performance of the TLD and TLCD can be accurately evaluated using the hybrid testing method without the physical structural model.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
발행 : 서울: 檀國大學校, 2006

Comparison between the structural responses obtained by the RHSTTM and the conventional shaking tabletest of a single story steel frame with TLD/TLCD indicates that the performance of the TLD/TLCD can be accurately evaluated using the RHSTTM without the physical structural model.

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Comparison between the structural responses obtained by the RHSTTM and the conventional shaking tabletest of a single story steel frame with TLD/TLCD indicates that the performance of the TLD/TLCD can be accurately evaluated using the RHSTTM without the physical structural model.

문장표절률: **88%**

11. The uncontrolled and TLD-controlled structural responses of a three- story structure are obtained by the hybrid testing method in both time and frequency domains, showing that TLD can effectively mitigate the seismic responses of buildingstructures and the hybrid testing method can reproduce the dynamic behavior of TLD-structure interactionsys- tems for both the uncontrolled and controlled case.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

Finally the uncontrolled and TLD-controlled structural responses of a three story structure are obtained by the RHSTTM in both time and frequency domains, showing that TLD can effectively mitigate the seismic responses of buildingstructures and the RHSTTM can reproduce the dynamic behavior of TLD-structure interactionsys tems for both the uncontrolled and controlled case.

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문장표절률: **0%**

12. The hybrid testing method canalso be applied to the performance eval- uation of new designed, tuned liquid typed damper which has strong inherent nonlinearity such as the TLMD.

문장표절률: **64%**

Secondary, this paper presents the design of excitation systems for sim- ulating dynamic loads. The controller design of an actuator is presented to simulate the responses of a buildingstructure subjected to such dynamic excitations as earthquakes and wind loads.

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The controller design of an actuator is presented to simulate the responses of a buildingstructure subjected to such dynamic excitations as earthquakes and wind loads.

문장표절률: **73%**

The result of the study can be summarized as follows. 1. A design of a shaker for simulating wind-induced responses of a build- ing structure was presented as a preliminary study for evaluating wind- resistance characteristics of practical buildingstructures.

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109 7. Conclusions (5) A design of a shaker for simulating wind induced responses of a build ing structure was presented as a preliminary study for evaluating wind- resistance characteristics of practical buildingstructures.

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저자 : 박은천
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109 ☐. Conclusions (5) A design of a shaker for simulating wind induced responses of a build ing structure was presented as a preliminary study for evaluating wind- resistance characteristics of practical buildingstructures.

문장표절률: **76%**

148 Chapter. 5. Conclusions 2. The force of the shaker was obtained using the inverse transfer func- tion of structural responses.

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(6) The force of the shaker was obtained using the inverse transfer func tion of structural responses. Also, band stop filter was used to remove zero of the transfer func tionsuch that undesirable modal excitation is prevented, and envelop fimc tion was used to reduce the error occurring in transient initial states.

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문장표절률: **100%**

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문장표절률: **98%**

3. The numerical analyses results from a 76-story benchmark building confirmed that the structural responses of a buildingstructure excited by wind loads acting at all floors could be reproduced by the proposed linear shaker installed at a specific floor.

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저자 : 박은천
발행 : 서울: 檀國大學校, 2006

The numerical analyses results fiom a 76-story benchmark building confirmed that the structural responses of a buildingstructure excited by wind loads acting at all floors could be reproduced by the proposed linear shaker installed at a specific floor.

문장표절률: **97%**

4. The performances of the excitation systems were dependent on type and position of the targetstructural response for which acceleration re- sponse was suitable because targeting displacement response required large and high-speed changing control force.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

저자 : 박은천
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저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

The performances of the excitation systems were dependent on type and position of the targetstructural response for which acceleration re sponse was suitable because targeting displacement response required large and high-speed changing control force.

문장표절률: **86%**

5. In order to enhance practical applicability of the wind responsesim- ulating excitation systems, finite element model updating based on measured data, and the scaling or restriction of the excitation force or stroke limit for avoiding damage to the practical building etc.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계

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문장표절률: **88%**

should be considered 6. The field measurementsystem of full-scale structure and excitation system were established, and thenforced vibration test was carried out using the Hybrid Mass Damper designed to simulate seismic load.

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저자 : 박은천
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저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

(7) The field measurementsystem of full-scale structure and excitation system were established, and thenforced vibration test was carried out using the Hybrid Mass Damper designed to simulate seismic load.

문장표절률: **57%**

7. System identification of full-scalestructure was carried out through white noise test, and the finite element modelis updated from mea- sured data.

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저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

(8) System identification of full-scalestructure was carried out through white noise test and Finite Element (FE) modelis updated.

문장표절률: **95%**

8. The seismic excitation system was accomplished through inverse trans- fer functions of structure and HMD by the system identifications.

[Copykiller] 건축구조물의 동적하중 구현 및 실시간 하이브리드 실험을 위한 가진시스템 설계 = Design of excitation systems for simulating dynamic loads and real-time hybrid test method of building structures

저자 : 박은천
발행 : 서울 : 단국대학교 대학원, 2007.2

The seismic excitation system was accomplished through inverse trans fer functions of structure and HMD by the system identifications.

문장표절률: **0%**

9. The normalized RMS response error through the experimental results showed more increasing one than numerical analysis.

문장표절률: **0%**

This phenomenon is caused by the errors due to the phase of the inverse transfer function of HMD caused by compensating for dynamic characteristics of HMD.

문장표절률: **0%**

10. In simulating the pseudo-earthquake response, unexpected modal re- sponses should be considered, when the excitation signal is generated by the inverse transfer function of structure, because it is measured non-existenterrors such as noises of structural response.

문장표절률: **0%**

11. The effectiveness of the MR damper-based control systems with var- ious control algorithms for seismic protection of full-scale five-story steel frame buildingstructure is experimentally verified in this paper.

문장표절률: **0%**

149 Chapter. 5. Conclusions 12. An MR damper is designed by deriving a suboptimal design procedure considering optimization problem and magnetic analysis, and manu- factured into 1.0ton MR damper to realizesemiactive control systems.

문장표절률: **0%**

13. Under the four historical earthquakes and one filtered artificial earth- quake, various semi-active control algorithms including the passive op- timal case are evaluated and compared with one another.

문장표절률: **0%**

14. The investigation of the hysteretic behavior of an MR damper and the seismic performance evaluation of a buildingstructure, installed with an MR damper, are experimentally implemented using the hybrid testing method.

문장표절률: **0%**

15. The Bouc-Wen modelis used to calculate the control force of the MR damper used in this study, and its parameters are identified based on the experimental results from the hybrid testing method, which used a sinusoidal wave as the ground input acceleration.

문장표절률: **0%**

16. The hybrid testing method is validated because the hybrid testing results from the sinusoidal and earthquake excitations and the corre- sponding analytical results agreed well with each other.

문장표절률: **0%**

17. To compare the results obtained from the hybrid testing method and the numerical analysis, Bouc-Wen model parameters are identified by each input current.

문장표절률: **0%**

The results of this comparison show that the hybrid testing method is more practical than the numerical analysis due to the non-linear variations of the reaction velocity and excitation frequency.

문장표절률: **0%**

18. The hybrid testing of MR damper results indicated that the seismic performance of a buildingstructure installed with an MR damper could be indirectly evaluated by the hybrid testing method, in which only the MR dampers are physically tes

ted.

문장표절률: **0%**

150 초 록 비선형 감쇠장치가 설치된 건축구조물의 내진 및 내풍 성능평가를 위한 하이브리드 실험기법 및 가진시스템 설계 박 은 천 건축공학과 단국대학교 대학원 지도교수 : 민경원 본논문은크게하이브리드실험법과동적응답을 구현하는가진시스템 설계법을 제안한다.

문장표절률: **0%**

첫째로 하이브리드 실험법은 전체 구조계에서 비선형 성이 강한 파트를 실험모델 그리고 선형거동할 것이라 예측되는 파트를 해석모델로 두고 실시간으로 그 응답을 받아 실험하는 기법이다.

문장표절률: **0%**

이러한 실험 방법은 실험모델과 해석모델의 인터페이스를 선정해야 하며 해석모델의 경계면은 실험모델의 가진력으로 작용하도록 설계하는 실험 시스템을 구축하여야 한다.

문장표절률: **0%**

본 논문은 진동대를 통해 구조계를 실험구조계와 해석구 조계로분리하여 하이브리드 실험을 하는부분구조실험법과비선형진동제어장치인 동조액체감쇠기, 동조액체기둥감쇠기 그리고 동조액체질량감쇠 기를 실험모델로 실험하고 건축구조몰을 해석모델로 계산하는 하이브리드 실험을 설계하고 실험하여 그 성능을 검증 하였다.

문장표절률: **0%**

더나아가 비선형성이 강 한 1톤급 충간형 감쇠기인 MR 감쇠기를 UTM에 장착하여 MR 감쇠기가 설치된 건물의 내진성능평가를 수행하고 MR감쇠기에 준능동 알고리즘을 적용하여 내진 제어성능을 실험적으로 평가하였다.

문장표절률: **0%**

이는 본 실험 방법을 통해 불특정 비선형성을가진 제어장치의 최적의 알고리즘 혹은 장치 자체의 성능을 실험적으로 찾아서 적용할 수 있는 가능성과 정량적 근거를 제시할 수 있었다.

문장표절률: **0%**

두 번째로 동적 응답을 구현하는가진시스템 설계법은 실물 크기 사용중 건물에서 선형질량가진기나 능동형질량감쇠기 등을 특정 층에 설치하고 유사지진 또는 유사 바람하중 응답을 구현하는 시스템이다.

문장표절률: **0%**

본논문에서는풍하중응답구현을 위해건물모델과풍하중데이터가있는 76층 벤치마크 건물을 대상으로 수치해석적으로 검증하였으며, 지진하중 구현을 위해 실물규모의 5층 건물의 HMD를 가진하여 지진하중을 구현하 151 초 록 였다.

문장표절률: **0%**

또한 이를 제어하는준능동감쇠장치인 1톤급MR감쇠기를설치하여 실물규모 건물에서 MR감쇠기의 지진에 대한 준능동제어 성능을 평가하였다.

문장표절률: **0%**

이러한 기법을 통해 실물 크기 건축구조물의 내진 및 내풍성능평가 가능하며 비선형 제어장치가 설치된 건물의 내진 및 내풍성능 또한 평가가능할 것이라 사료된다.

문장표절률: **0%**

본 논문의 2장에서 하이브리드 실험법을 제안한다. 첫째로 하이브리드 실험법을이용한 건축구조물의부분구조실험을진동대를사용하여 수행하였다.

문장표절률: **0%**

전단형 건축구조물의 특정 층을 경계면으로 선정하여 목표 구조물의 상부부분을 실험적 부분구조로 그리고 하부부분을 수치해석적 부분구조로 나눈다. 부분구조로 분리된 경계면에 존재하는 경계 하중은 실험 모델의 절대가속도 응답의 실시간으로 피드백하여 계산된다.

문장표절률: **0%**

두 부분구조의 경계면의 가속도는 수치해석부 부분구조의 실시간 시간이력해석을 통해 계산되고 진동대 제어기의 명령 신호로 사용된다.

문장표절률: **0%**

이때 명령 신호를 생성하는 진동대 제어기는 명령 신호와 실험부 부분구조의 가진을 위해 생성된 진 동대 운동과의 오차를 최소화한다.

문장표절률: **0%**

하이브리드 실험법의 진동대부분구조 실험의 유효성과 정확성은 진동대 실험을 통해 실험 결과와 수치해석 결과의 일치한 결과를 얻었다.

문장표절률: **0%**

두 번째로 비선형 제어장치인동조액체형감쇠기 (TLD, TLCD 및 TLMD)의 지진가진을 받는 건축구조물의 제어성능 평가를 위한 하이브리드 실험법이 실험적으로 수행되었다.

문장표절률: **0%**

비선형 제어장치를 실험모델로 건축구조물을 해석모델로 구분하여 실험을 수행하므로 물리적 건축구조물 없이 단지 TLD, TLCD 및 TLMD와 로드 셀 그리고 진동대만을 사용하여 실험한다.

문장표절률: **0%**

TLD, TLCD그리고 TLMD의실험체하부에 장착된 로드 셀을 통해 계측된 전단력과 지진파인 지반가속도를 해석 건물모델에 지반가속도로가진을 하며 이때 구조물의 응답에서 제어장치가 설치된 층 의절대가속도를진동대로구현된다.

문장표절률: **0%**

TLD, TLCD그리고 TLMD는 설치된 층의 절대가속도로 거동하며 계측된 하부의 전단력을 다시 건물의 설치된 층에전달하게되고설치된층의제어시혹은비제어시절대가속도를재생산하며 실험이 진행된다.

문장표절률: **0%**

본 논문은 하이브리드 실험과 기존의 전체구조계 실험을 비교하여 계측된 응답의 일치한 결과를 얻었고 물리적 구조물 모델 152 초 록 없이 하이브리드 실험법을 사용하여 비선형 진동제어장치가 설치된 건물의 내진성능을 정확하게 평가할 수 있음을 제시한다.

문장표절률: **0%**

본 논문에서 기존 연구와많은사례를 통해 검증된 TLD와 TLCD뿐만 아니라 새롭게 제안한 양방향 응답을 제어하기 위한 장치인 TLMD의 하이브리드 실험법을 통해 양방향 제어성능을 파악함으로써 하이브리드 실험이 설계 단계에서 실험적으로 평가할 수 있어 매우 유용하다.

문장표절률: **0%**

3장에서는건축구조물의동적하중응답을 구현하기 위한가진시스템을 제안한다. 가진기의 힘은 가진기에 의한 구조물의 역전달함수를 통해 계산되고 필터와 포장함수는 가진기의 예측하지 않은 모드 응답과 초기 과도응답을 방지하기 위해 사용되었다.

문장표절률: **0%**

풍동실험을 통해 얻은바람하중이 주어진 76층 벤치마크 건축구조물의 수치해석결과는 특정 층에 설치된 가진 시스템은 각층에 가해지는바람하중에의한응답을근사하게나타낼 수있음을 보여준다.

문장표절률: **0%**

제안한 방법에 의해 설계된가진시스템은실제건축구조물의내 풍특성을 평가하는데그리고바람하중가진을받는건축구조물의 정확한 해석 모델을 수립하는데, 효과적으로 사용될 수 있다.

문장표절률: **0%**

또한, 복합 질량 감 쇠기(Hybrid Mass Damper, HMD)를 이용하여 지진하중을 모사하는 실물 규모의강제진동실험이 수행되었다.

문장표절률: **0%**

구조물의해석모델은유한요소법으로 구축하였고, 유한요소모델은 강제진동 실험을 통해 얻은 계측데이터를 통해 주파수 영역과시간영역시스템 식별을 수행하여 수정되었다.

문장표절률: **0%**

유사지진 가진실험은 HMD에의한층별가속도 응답이 수정된유한요소모델의지진 하중에의한응답과 일치함을 보여주었다. 또한, 층간형제어장치가 설치된 건물의 내진성능 검증하기 위해 1톤급의 MR 감쇠기를 제작 설치 되었으며 지진하중 가진 강제진동실험을 통해 MR 댐퍼의 여러 준능동 알고리즘과 최적 수동 상태에서의 내진성능을 실험적으로 평가할 수 있었다.

문장표절률: **0%**

마지막으로 4장에서는 3장에서 실험한 준능동 MR 감쇠기를 이용하여 2장에서 제안한 하이브리드 실험 기법으로 건축구조물에 설치된 MR 감쇠 기의수동제어와준능동제어 성능을 실험적으로 평가하였다.

문장표절률: **0%**

건물모델은 3장에서 수행한 실험으로해석모델을 구축 하였으며, MR감쇠기는 UTM에 장착하여 물리적인 실험모델로 건물 모델을 해석모델로 실험을 수행하게 153 초 록 된다.

문장표절률: **0%**

먼저 건물 모델의 MR 감쇠기가 위치한 층의 변위가 발생하면 UTM에그변위를전달하게 되며 이때 발생한MR감쇠기의힘은 UTM에 설치된 로드 셀에서 계측된다.

문장표절률: **0%**

이를 다시 건물 모델을 제어하는 힘으로 환산되어 건물 응답을 제어하는 방식으로 가진 된다.

문장표절률: **0%**

본 연구에서는 준능동 실험을 위해 하이브리드 실험에서 구조물의정현파가진을통한공진시얻은실험 결과로 MR 감쇠기를 비선형 모델을 단순 Bouc-Wen 모델로 식별하였으며, 매개변수연구를 수행 하였고이단순 Bouc-Wen모델을 이용한수치해석결과와 하이브리드 실험 결과와 매우 잘 일치함을 확인하였다.

문장표절률: **0%**

또한, Passive- on 및 Passive-off 제어에 대한 하이브리드 실험의 결과는 과도한 제어력에 의해 가속도 응답이 많이 감소하지 않았지만, 변위 응답은 MR 댐퍼에 인가된 전류의 증가로 감소하고 있음을 보여주었다.

문장표절률: **0%**

건물의 최적제어를 위한 MR 댐퍼의 두개의 준능동제어 알고리즘을 적용하였고 이는 내진성능과 관련하여 각 알고리즘에 대하여 고찰하였다.

문장표절률: **0%**

실험과 수치해석의 비교결과에서 뿐만 아니라 3장에서 수행한실물규모건물의지진하중강제진동실험 결과와 비교에서도 유사한 결과를 얻어 하이브리드 실험법이 내진 성능평가 측면에서 기존의 강제진동실험방식과 비교하여 실용적이다.

문장표절률: **0%**

주요어:하이브리드실험, 부분구조실험, 비선형진동제어장치, 동조액체 감쇠기, 동조 액체기둥 감쇠기, 동조 액체질량 감쇠기, 제어-구조상호력, 가진기 동특성 보상, 능동 질량 감쇠기, 복합형 질량 감쇠기, 가진 제어기 설계, 76층 벤치마크 건축구조물, 강제 진동 실험, 시스템 식별, 유한요소 모델 업데이트, 자기유변유체 감쇠기, 준능동제어 알고리즘. 학 번 : 72070621 154

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철도차량의 주행 안정성 분석시스템(System for driving stability anal- ysis of Railway vehicle) 출원번호 : 1020110068195

문장표절률: **0%**

등록번호 : 1012590880000 출원인 : 한국유지관리 주식회사 출원일자 : 2011.07.11 등록일자 : 2013.04.23

문장표절률: **0%**

공개일자 : 2013.01.21 발명자 : 최준성, 강형구, 박은천, 김만철, 유원희 이상 진단 사전감시 방법(Method for preliminary surveillance of fail-

문장표절률: **0%**

ure diagnosis) 출원번호 : 1020120138404 출원인 : 한국유지관리 주식회사 출원일자 : 2012.11.30 공개일자 : 2014.06.13

문장표절률: **0%**

발명자 : 최준성, 임공철, 이은찬, 박은천 174 Curriculum Vitæ 유에스엔 기반 지능형 교량 모니터링 및 안전성 평가 시스템(System for

문장표절률: **0%**

intelligent monitoring and safety evaluation of bridge based on USN) 출원번호 : 10-2011-0026810 출원인 : 한국유지관리 주식회사

문장표절률: **0%**

출원일자 : 2011.03.25 공개일자 : 2012.10.17 발명자 : 최준성, 박은천, 윤종구 Relevant Skills Computer Programming

문장표절률: **0%**

Mathworks MATLAB, Mathworks Simulink, National Instruments Lab- VIEW, Visual Studio (C#, C++) Python, Node.js, Javascript, SQL, NoSQL(MongoDB), Shellscript of

문장표절률: **0%**

Linux(Debian) Referees Kyung-Won : Professor, Advisor Min, Ph.D. Dept. of Architectural Engineering of Dankook Univer- sity E-mail : kwmin@dankook.ac.kr Phone : +82-31-8005-3734 Sang-Hyun : Professor Lee, Ph.D.

문장표절률: **0%**

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