**Literature Planner**

**Student Name:** Chengxin Huo  **Student Number:** 7420262

**Topic:** Joint control of Magnetorheological Fluid Dual Clutch and motor

**Reference Number:** 1 **Authors:** Yiyi Liang et al.

**Title of Article:** Investigation of Data-driven Modelling and Feedforward Control for a Two Speed Magnetorheological Fluid Dual Clutch Transmission of Electric Vehicles

**Type:** Conference Paper

**Publication:** International Conference on Electric Vehicle and Vehicle Engineering (CEVVE 2023)

**Year Published:** 2023 **Number of citations:** 0

**Primary or Secondary:** Primary

**Publication Rating:**

*CiteScore:N/A Rank: N/A Percentile: N/A In-Category: N/A CiteScore Year: N/A*

**What themes were discussed in the Literature Review?** MRF dual-clutch (MRFDC) design, data-driven modelling technique, Dynamic Mode Decomposition with Control (DMDc) , proportional-integral-derivative (PID) control

**What was the research question?**

Using the pure data-driven modelling technique of "Dynamic Mode Decomposition with Control (DMDC)", explore the correlation between the input current and output torque of the MRFDCT system.

**Design:**

DMDc was used to develop linear state space models for the input currents and output torques under several scenarios: sinusoidal and step responses of the upshifting process. Under different scenarios, compare the differences between the linear state space model generated by DMDC and the physical model of MRFDC **What was the finding?**

Under different scenarios, the associated linear state-space models generated by DMDc are able to accurately predict experimental results, validating their effectiveness. The inverse models of MRFDCT were constructed by utilising the same DMDc method and reversing the input current and output torque.

**What were the gaps?**

Not compared with the direct PID control effect

**Reference Number: 2 Authors:** Jin Zhao et al.

**Title of Article:** Modeling and Torque Control Against Rate-Dependent Hysteresis of a Magnetorheological Fluid Dual Clutch in an Electric Vehicle Transmission System

**Type:** Journal Paper **Publication:** IEEE

**Year Published:** 2024 **Number of citations:** 1

**Primary or Secondary:** Primary

**Publication Rating:**

*CiteScore: 11.6 Rank: 27/231 Percentile: 91%*

*In-Category: Control and Systems Engineering CiteScore Year: 2023*

**What themes were discussed in the Literature Review?**

magnetorheological fluid clutches (MRFCs), Bouc–Wen model, super-twisting algorithm

**What was the research question?**

During these transients, their dynamic features should be figured out, and transmission torque should be controlled with fast response and high accuracy.

**Design:**

A modified Bouc–Wen model with model uncertainty observer is developed to describe the relationship between input currents and output torque of a magnetorheological fluid dual clutch (MRFDC) considering the rate-dependent hysteresis. Then, torque control is implemented by compiling an inverse model feedforward, real-time hysteresis observer, and super-twisting algorithm based on the model. Simulations are conducted to validate the model accuracy, and the control strategy is evaluated by experiments on a MRFDC transmission platform.

**What was the finding?**

Experimental results validate that the proposed control strategy can perform good torque control performance in both transient and steady states.

**What were the gaps?**

The hysteresis observer's suppression effect on the tracking error of clutch 2 is not ideal enough

**Reference Number:** 3 **Authors:** Huan Zhang et al.

**Title of Article:**

A novel magneto-rheological fluid dual-clutch design for two-speed transmission of electric vehicles

**Type:** Journal Paper **Publication:**Smart Materials and Structures

**Year Published:** 2021  **Number of citations:**10

**Primary or Secondary:** Primary

**Publication Rating:**

*CiteScore:7.5 Rank: 59/379 Percentile: 84%*

*In-Category:* *Civil and Structural Engineering CiteScore Year: 2023*

**What themes were discussed in the Literature Review?**

magneto-rheological fluid (MRF), MRF dual-clutch (MRFDC), Herschel-Bulkley model,

**What was the research question?**

Establish an output torque model for MRFDC that considers magnetic flux density.

**Design:**

The relationship between the input current and the magnetic flux density is obtained by the finite element analysis of the magnetic field under different input current. Theoretical analysis is carried out to estimate the output torque of MRFDC according to the geometric dimensions of MRFDC structure and rheological properties of MRF.  the relationship between the transmissible torque and applied input current is determined. Finally, the MRFDC model is experimentally verified on the testbed; besides, the transmissible torque tests and response time tests for internal and external MRF clutches are carried out, respectively.

**What was the finding?**

The test results agree with the simulation results, and the differences are within 2 N m.

**What were the gaps?**

Not taking into account the issue of partial magnetic leakage in the physical object

**Reference Number: 4 Authors:** Manuel A. Fernández; Jen-Yuan Chang

**Title of Article:** Development of magnetorheological fluid clutch for robotic arm applications

**Type:** Conference Paper

**Publication:** **I**nternational Workshop on Advanced Motion Control (AMC)

**Year Published:** 2016 **Number of citations:18**

**Primary or Secondary:** Primary

**Publication Rating:**

*CiteScore:N/A Rank: N/A Percentile: N/A In-Category: N/A CiteScore Year: N/A*

**What themes were discussed in the Literature Review?**

Magneto mechanical effects, Fluids, Torque, Magnetic fields, Mathematical model, Stress, Magnetic cores

**What was the research question?**

 A cylinder-based clutch was designed and built, and whether the objectives were satisfied

**Design:**

The measurements were performed with six magnet positions and five speeds, giving a total of 30 different configurations. The force measured by the transducer was recorded for sixty seconds in order to let the system stabilize. From this data, the last 600 samples, corresponding to about 20 seconds, were averaged out and then multiplied by the lever arm's length in order to obtain the average torque. The standard deviation of the 600 samples was also multiplied by lever arm's length to calculate error margins.

**What was the finding?**

The results from the measurements performed on the clutch are not as expected according the theoretical model.

**What were the gaps?**

torque-distance curves is non-linearity.

**Reference Number: 5 Authors:** Joshua L. Proctor et al.

**Title of Article:** Dynamic Mode Decomposition with Control

**Type:** Journal Paper

**Publication:** SIAM Journal on Applied Dynamical Systems

**Year Published:** 2016 **Number of citations:**1050

**Primary or Secondary:** Primary

**Publication Rating:**

*CiteScore:3.6 Rank:30/193 Percentile:84%*

*In-Category:* *Analysis CiteScore Year:2023*

**What themes were discussed in the Literature Review?**

Model reduction, dynamic mode decomposition, data-drive, equation-free, input-output models

**What was the research question?**

The new method extends Dynamic Mode Decomposition (DMD) to incorporate control effects, thereby extracting low order models from high-dimensional complex systems.

**Design:**

The Paper construct a sparse dynamical system in a two-dimensional Fourier domain. Only ﬁve modes are allowed to be nonzero. The dynamical system on these spatial modes is constructed in the following way: for each mode, a temporal oscillation frequency is chosen randomly, and a small, stable damping rate is similarly chosen. The boundary conditions are periodic, thus restricting the dynamics toa torus. Though, the example is extended to allow for actuation in the spatial domain. The spatial actuation is then Fourier transformed in order to compute the eﬀect on the underlying dynamical system. The spatial grid used is 128 × 128

**What was the finding?**

The underlying dynamics of the system can be discovered solely from state and control snapshots in the spatial domain using DMDc.

**What were the gaps?**

Adapting DMDc using OKID subspace identiﬁcation methods as a generalization of the method could be quite impactful.

**Reference Number: 6 Authors:** SCHMID, PETER J.

**Title of Article:** Dynamic mode decomposition of numerical and experimental data

**Type:** Journal Paper **Publication:** Journal of Fluid Mechanics

**Year Published:** 2010 **Number of citations:**5713

**Primary or Secondary:** Primary

**Publication Rating:**

*CiteScore:6.5 Rank: 56/635 Percentile: 91%*

*In-Category:* *Applied Mathematics CiteScore Year:2023*

**What themes were discussed in the Literature Review?**

coherent features of fluid flow, plane channel flow, flow over a two-dimensional cavity, wake flow behind a flexible membrane, a jet passing between two cylinders.

**What was the research question?**

The accurate description of the disturbance behaviour in complex geometries poses

**Design:** To demonstrate the convergence behaviour of the dynamic mode decomposition, paper use a numerically generated sequence of snapshots from a spectral discretization of the two-dimensional linearized Navier–Stokes equations for plane Poiseuille flow. The governing equations have been formulated as an evolution equation for the wall normal velocity v, and 150 Chebyshev polynomials have been used to discretise the wall-normal direction; a matrix exponential has been used to advance the flow fields over a fixed time interval t = 0.1. After a transient period of ten time-steps, v-flow fields are sampled at intervals of t = 0.1. For demonstration purposes, we choose a Reynolds number of Re = 10 000, based on the centreline velocity and half-channel height. Furthermore, we take an initial perturbation that has a unit streamwise wavenumber α = 1. This flow configuration is often used as a benchmark problem for stability calculations and shall in paper case give a first impression of the accuracy and convergence behaviour of the dynamic mode decomposition

**What was the finding?**

the structures (and eigenvalues) identified by the dynamic mode decomposition correctly and accurately capture the temporal behaviour contained in the processed data sequence.

**What were the gaps?**

For experimental data no such decomposition exists that could provide temporal dynamic characteristics together with spatially coherent structures.

**Reference Number:** 7 **Authors:** Paul D. Walker et al.

**Title of Article:** Dynamics and Control of Clutchless Automated Manual Transmissions for Electric Vehicles

**Type:** Journal Paper **Publication:** Journal of vibration and acoustics

**Year Published:** 2017 **Number of citations:**50

**Primary or Secondary:** Primary

**Publication Rating:**

*CiteScore:4.2 Rank: 12/44 Percentile: 73%*

*In-Category:* *Acoustics and Ultrasonics CiteScore Year:2023*

**What themes were discussed in the Literature Review?**

Dynamics, Machine dynamics, Mechatronic systems , Electro-mechanical systems

**What was the research question?**

The dynamics and control of clutchless automated manual transmissions (CLAMT) for the purpose of investigating the system behavior during up and down shifts.

**Design:**

a multibody dynamic model of the proposed powertrain is implemented to simulate the transient behavior of the system, including a direct current (DC) equivalent model of the electric machine (EM) and a synchronizer mechanism model. Closed-loop control of motor speed and torque is used in conjunction with synchronizer mechanism actuation to functionally achieve gear shifting without the need for a primary friction clutch. To evaluate the performance of shift control, shift metrics including longitudinal jerk, vibration dose value (VDV), and shifting duration are evaluated from simulation results.

**What was the finding?**

the most significant impact on the transient response of the powertrain results from the reduction and reinstatement of motor torque during shift control. Speed control of the motor during the shift transient directly impacts on the duration of shifting, but not the transient response of the powertrain.

**What were the gaps?**

implementation of optimal control strategies that balance the conflicting metrics of shift duration and vehicle jerk. Experimental verification of these results using the UTS Powertrain Test Rig,

**Reference Number:** 8 **Authors:** D H Wang et al.

**Title of Article:** Magnetorheological fluid dampers: a review of parametric modelling

**Type:** Journal Paper **Publication:** Smart Materials and Structures

**Year Published:** 2011 **Number of citations:**583

**Primary or Secondary:** Primary

**Publication Rating:**

*CiteScore:7.5 Rank: 59/379 Percentile: 84%*

*In-Category:* *Civil and Structural Engineering CiteScore Year: 2023*

**What themes were discussed in the Literature Review?**

magnetorheological (MR) dampers, identification method.

**What was the research question?**

 no simple parametric models with high accuracy for MR dampers can be found. In addition, the parametric dynamic models for MR dampers with on-line updating ability and the inverse parametric models for MR dampers are scarcely explored.

**Design:**

In order to test the performance of MR dampers and validate the dynamic models for MR dampers, various kind of experimental set-ups, which can be categorized as servo hydraulic actuator-based systems and shaker based systems, are established. All the experimental results are measured with the experimental set-up.

**What was the finding?**

although the force–velocity behaviour appears to be reasonably modelled by the model, examination of the force–velocity response and the temporal variation of the force shows that the behaviour of the damper is not well captured, especially for velocities that are near zero.

**What were the gaps?**

1. The force–displacement behaviour of MR dampers is well represented by most of the proposed dynamic models for MR dampers.
2. (ii) No simple parametric models with high accuracy for MR dampers can be found, although various kinds of models for MR dampers have been proposed and validated.
3. (iii) The inverse parametric dynamic models for MR dampers are still immature and need to be further developed.
4. (iv) The parametric dynamic models for MR dampers with online updating ability are scarcely explored. (v) Whether one dynamic model for MR dampers can portray the force–displacement and force–velocity behaviour is not only determined by the dynamic model itself but also determined by the identification method.

**Reference Number:** 9 **Authors:** Xingxing Zhou et al.

**Title of Article:** Numerical and experimental investigation of drag torque in a two-speed dual clutch transmission

**Type:** Journal Paper **Publication:** Mechanism and Machine Theory

**Year Published:** 2014 **Number of citations:**132

**Primary or Secondary:** primary

**Publication Rating:**

*CiteScore:9.9 Rank: 47/672 Percentile: 93%*

*In-Category:* *Mechanical Engineering CiteScore Year:2023*

**What themes were discussed in the Literature Review?**

Drag torque, Power loss, Mathematical model, Dual clutch, transmission, Experimental investigation

**What was the research question?**

The theoretical analysis of drag torques within a two-speed dual clutch transmission

**Design:**

The test procedure used for collecting the data was the following. For a given group of operating conditions (gear, speed, motor torque, and lubricating oil temperature) the test rig was operated and stabilized last for at least 2 min. Then average one is chosen. And the error of efficiency is ± 1%. Via comparing the input and output torque of transmission under different driving conditions, the difference of total drag torque power loss can be measured by a torque sensor.

**What was the finding?**

The result are very close to the speeds obtained from test results. The differences between simulation and test results are smaller, less than 0.5%. It appears that the simulation results are always a little higher than test results by 0.2% in efficiency.

**What were the gaps?**

The limitation of this work does not consider the influences of temperature on drag torque.

**Reference Number:** 10 **Authors:** Paul Walker et al.

**Title of Article:** Powertrain dynamics and control of a two speed dual clutch transmission for electric vehicles

**Type:** Journal Paper **Publication:** Mechanical Systems and Signal Processing

**Year Published:** 2017 **Number of citations:** 164

**Primary or Secondary:** Primary

**Publication Rating:**

*CiteScore:14.8 Rank: 3/153 Percentile:98%*

*In-Category:* *Aerospace Engineering CiteScore Year:2023*

**What themes were discussed in the Literature Review?**

Electric vehicle, Powertrain, Dual clutch transmission, Shift control

**What was the research question?**

Simulation and experimental studies of the shift transient behaviour of dual clutch transmission equipped electric vehicle powertrains is undertaken.

**Design:**

The powertrain system comprises of the front wheel drive assembly of a large passenger sedan. The wheels drive a set of flywheels that simulate the inertial load of a vehicle equivalent to 1500 kg. The resistance torque is applied to the system using another axle that drives an [eddy current](https://www-sciencedirect-com.ezproxy.uow.edu.au/topics/earth-and-planetary-sciences/eddy-current) [dynamometer](https://www-sciencedirect-com.ezproxy.uow.edu.au/topics/engineering/dynamometer). The DCT block represents a DQ250 transmission that has been modified for two speed operation as discussed in [Section 2](https://www-sciencedirect-com.ezproxy.uow.edu.au/science/article/pii/S0888327016302692?via%3Dihub" \l "s0010). The system is controlled by custom software implemented on MicroAutoBox for the VCU/TCU. The motor is a brushless DC motor with a continuous power of 45 kW and peak of 125 kW, it is controlled using the inverter drive which is integrated with the VCU. Sensors, denoted by ‘S′, represent the location of two wireless torque transducers of the [strain gauge](https://www-sciencedirect-com.ezproxy.uow.edu.au/topics/earth-and-planetary-sciences/strain-gage) type. A number of other sensors (not shown) collect motor speed, voltage, current, motor torque, and transmission output speed.

**What was the finding?**

Results achieved both experimentally and through simulation demonstrated that it is possible to achieve high quality gear shifts using torque based control techniques.

**What were the gaps?**

**Reference Number:** 11 **Authors:** Manas Ranjan Sial et al.

**Title of Article:** SOGI-FLL-2DOF PID—A Combined Second-Order-Generalized-Integrator-Based FLL and Two-Degree-of-Freedom PID Current Control for Switched Reluctance Motor Drives

**Type:** Journal Paper

**Publication:** IEEE Journal of Emerging and Selected Topics in Industrial Electronics

**Year Published:** 20233 **Number of citations:1**

**Primary or Secondary: primary**

**Publication Rating:**

*CiteScore:N/A Rank: N/A Percentile: N/A In-Category: N/A CiteScore Year: N/A*

**What themes were discussed in the Literature Review?**

switched reluctance motors (SRMs), second-order-generalized-integrator (SOGI), two-degree-of-freedom proportional-integral-derivative (2DOF-PID) controller

**What was the research question?**

 This study examines four distinct controllers employed in SRMs, each possessing unique advantages and disadvantages in terms of mitigating torque ripple at various speed levels, enhancing output torque power, and maintaining decreased overshoots throughout a broad speed range.

**Design:**

The SRM and its proposed current control mechanism are tested in MATLAB/Simulink under various operating conditions. The results of the quintic TSF algorithm are also displayed for comparison while keeping the turn-on, turn-off, and turnOV angles the same. The simulation step time of the model is 10 μs. The asymmetric power converter uses a unipolar switching PWM approach to power the motor. The excitation angles (θon,θof f , and θov) are kept constant in all simulations at 10◦,130◦, and 35◦, respectively (0◦and 180◦ are represented as aligned and unaligned positions, respectively)

**What was the finding?**

When current control is applied, the interaction of the sensors, load, and SRM results in high commutation torque ripple and oscillations. When the proposed SOGI-FLL-2DOF PID current controller is applied, these features are significantly reduced. In addition, root-mean-square (RMS) torque ripple results show that torque ripple has been decreased by current profiling

**What were the gaps?**

No physical testing has been conducted

**Reference Number:12 Authors:** Tayfun Gundogdu et al.

**Title of Article:** Self-tuning PID control of a brushless DC motor by adaptive interaction

**Type:** Journal Paper

**Publication:** IEEJ Transactions on Electrical and Electronic Engineering

**Year Published:** 2014 **Number of citations:**11

**Primary or Secondary:** priamry

**Publication Rating:**

*CiteScore:2.7 Rank: 447/797 Percentile: 43%*

*In-Category:* *Electrical and Electronic Engineering CiteScore Year:2023*

**What themes were discussed in the Literature Review?**

adaptive interaction, adaptive control, adaptive neural network, self-tuning, proportional integral derivative (PID) controller, brushless DC (BLDC) motor control.

**What was the research question?**

A self-tuning algorithm for proportional integral derivative (PID) control based on the adaptive interaction (AI)approach theory efﬁciently used in artiﬁcial neural networks (ANNs) is proposed. The same adaptation as the well-known backpropagation algorithm (BPA) can be achieved without the need of a feedback network, which would propagate the errors, by applying adaptive interaction.

**Design:**

In order to simulate the behaviour of the prepared self-tuning PID, MATLAB Simulink model of the proposed method is per-formed. The reference speed, actual speed, and error curves for the speed control of the DC motor, whose transfer function is given, are determined using the Simulink models under the steady-state condition. The motor speed is controlled so as to follow the reference speed, which is designed in MATLAB via a signal generator. In this study, a brushless BLDCM of 140 V, 2.536 kW,24.4 A, 30 Nm, 1000 rpm (104.72 rad/s) and having the following parameters is used: Ra = 0.314 , La = 1.97 mH, J = 0.0241kgm2 , B = 0.3 Nm/rad/s, K e = K t = 1.22 Nm/A [19]. And a random load (TL) whose sample time is variable and changes between5 and 30 Nm is applied to the BLDCM to observe the adaptation. In order to model the system more realistically, sensor noise and the effect of the A/D converter signal are taken into account.

**What was the finding?**

The gains of the AIPID controller shows mooth changes even if the load torque shows very sharp and large changes

**What were the gaps?**

Surrounding the physical object for testing

**Reference Number:** 13 **Authors:** Devendra Somwanshi et al.

**Title of Article:** Comparison of Fuzzy-PID and PID Controller for Speed Control of DC Motor using LabVIEW

**Type:** Journal Paper **Publication:** Procedia Computer Science

**Year Published:** 2019 **Number of citations:**134

**Primary or Secondary:**Primary

**Publication Rating:**

*CiteScore:4.5 Rank:71/232 Percentile: 69%*

*In-Category:* *General Computer Science CiteScore Year:2023*

**What themes were discussed in the Literature Review?**

DC Motor, Fuzzy Logic, LabVIEW, PID Controller

**What was the research question?**

Comparing the advantages and disadvantages of fuzzy PID controller and ordinary PID controller for DC motor control

**Design:**

From the defined rules system speed is to reach the reference value. For example, rule is, 'if e(t) is NS then u(t) is DN'. This rule is explained as; if error value is negative small then output will be negative big. All inputs and outputs are in the form of linguistics term so it is necessary to convert them in to crisp value. Fam Table is to be created for designing the rules for Fuzzy designer. For conversion of linguistic terms in crisp value Fuzzy Membership Functions are used. Ranges are defined for all membership functions is -10 and 10

**What was the finding?**

Performance parameters are found individually for both controllers which are as for PID Controller rise time 0.009sec & settling time 0.082sec, for Fuzzy-PID Controller rise time 0.006sec & settling time 0.066sec. When results of designed Fuzzy-PID Controller is compared with the previous work then damping ratio improved by 10%, rise time improved by 30%, settling time reduced to 20% and peak time improved by 25% for PID Controller and for Fuzzy PID Controller damping ratio improved by 14.29%, rise time improved by 58.57%, settling time reduced to 19% and peak time improved by 30%. Fuzzy-PID Controller performs better than other Controllers which in fact extend from robustness of the system to the parameter variation.

**What were the gaps?**

Instead of general DC Motor some specified DC Motor can be taken into considerations and Optimization methods can be applied on them. It will improve their performances. Neural network can also be applied. Number of Rules can be applied for more improved results.

**Reference Number:** 14 **Authors:** Aleksei Tepljakov et al.

**Title of Article:** Incorporation of fractional-order dynamics into an existing PI/PID DC motor control loop

**Type:** Journal paper **Publication:** ISA Transactions

**Year Published:** 2016 **Number of citations:** 113

**Primary or Secondary:** Primary

**Publication Rating:**

*CiteScore:11.7 Rank:16/635 Percentile: 97%*

*In-Category:* *Applied Mathematics CiteScore Year: 2023*

**What themes were discussed in the Literature Review?**

Fractional calculus, Fractional PID control, SISO control, Process control, Controller tuning, DC motor, Servo system

**What was the research question?**

This paper presents a method for incorporating fractional-order dynamics in an existing DC motor control system with internal PI or [PID controller](https://www-sciencedirect-com.ezproxy.uow.edu.au/topics/engineering/derivative-controller), through the addition of an external controller into the system and by tapping its original input and output signals.

**Design:**

In this work, the following particular configuration of the INTECO modular servo syst, in which the objective is to control the [angular velocity](https://www-sciencedirect-com.ezproxy.uow.edu.au/topics/physics-and-astronomy/angular-velocity) of the DC motor. This modular experimental platform consists of the following components: a [tachogenerator](https://www-sciencedirect-com.ezproxy.uow.edu.au/topics/engineering/tachogenerator), a 24 V DC motor, an inertia load, a magnetic brake, an encoder, and a [gearbox](https://www-sciencedirect-com.ezproxy.uow.edu.au/topics/earth-and-planetary-sciences/transmission-machine-elements). The servo system may be interfaced with the MATLAB/Simulink environment through a specific PCI board, where data is collected from the encoder and tach generator, and is sent to the power drive box, which controls the DC motor.

**What was the finding?**

 It was shown that an external controller *CR*(*s*) could be designed, implemented and incorporated into the feedback control system by just obtaining the input and output signals without any changes in the configuration of the original DC motor system. Both simulation and experimental results show that such retuning capability is possible in the essence of improving system׳s robustness, e.g., incorporating iso-damping property.

**What were the gaps?**

further analysis should conclude retuning method with prospective industrial applications. The issue of efficient realization of the retuning controllers will also be studied.

**Reference Number:** 15 **Authors:** Salman Jasim Hammoodi et al.

**Title of Article:** Design and implementation speed control system of DC Motor based on PID control and matlab simulink

**Type:** Journal paper

**Publication:** International Journal of Power Electronics and Drive Systems

**Year Published:** 2020 **Number of citations:**63

**Primary or Secondary:** Primary

**Publication Rating:**

*CiteScore:3.5 Rank:120/272 Percentile: 56%*

*In-Category:* *Energy Engineering and Power Technology CiteScore Year:2023*

**What themes were discussed in the Literature Review?**

DC Motor, MATLAB/SIMULIK, PID, PWM, Speed control

**What was the research question?**

The objective of this work is to designed and simulate a new control system to keep the speed of the DC motor constant before variations of the load (disturbances), automatically depending to the PID controller.

**Design:**

MATLAB/SIMULINK toolbox is used in this paper to model the full system, it consists of DC motor fed by a DC source voltage through a chopper transistor circuit. A single of GTO-1 thyristor with its full control circuit and a free wheeling diode form the chopper circuit. The GTO-1 is a switch modelled. The switch block model has three terminals: the middle terminal is a controls which of the two other terminals is routed to the output. The control input signal is one, DC V is leading to the output voltage, on the other hand, the control input singals is zero, a zero will be leading to the output. The DC motor drives system with a mechanical load characterized by inertia (J), friction coefficient (B), and torq of the load (TL). The control circuit of the DC motor system consists of a speed control loop. A proportional-integral-Derivative (PID) controlled the speed of the control loop senses the actual speed of the DC motor, and compares the measuring speed with the reference speed (constant value) to determine the reference armature current will be required by the DC motor. One may notice that any difference in actual speed is a measure of the current of the motor required by the engine.

**What was the finding?**

The result shows a fast response of the PID control system of the system

**What were the gaps?**

Simulation was only conducted on a computer without physical verification