

Zibo Liu

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RESEARCH FIELD, EXPERTISE AND SKILLS

Keywords: “**acoustics; vibroacoustics; wave propagation; analysis of mechanical/acoustic properties; sound insulation and absorption; sound radiation; structural analysis; Finite Element method; signal analysis, acoustic measurement**”

Interested in the vehicle, aeronautical/aerospace engineering or the related fields, for acoustic analysis, NVH control, active and passive noise control, vibration isolation, noise reduction, modal analysis, *etc.*, in order to design, analyze, and improve the corresponding acoustical systems.

EDUCATION

- SEP. 2014 – MAR. 2019 **Doctor of Philosophy**
STOCKHOLM, SWEDEN
Department of Aeronautical and Vehicle Engineering
KTH Royal Institute of Technology
- SEP. 2011 – JUN. 2014 **Master of Science**
CHANGSHA, CHINA
Theoretical Acoustics
National University of Defense Technology
- SEP. 2007 – JUN. 2011 **Bachelor of Engineering & Bachelor of Business Administration**
BEIJING, CHINA
Applied Mechanics & Business administration
Beijing Institute of Technology

SCIENTIFIC PAPERS

- [1] **Liu, Z.**, Rumpler, R. and Feng, L., 2020. Locally resonant metamaterial curved double wall to improve sound insulation at the ring frequency and mass-spring-mass resonance. *Mechanical Systems and Signal Processing*, 149, p.107179. doi: 10.1016/j.ymssp.2020.107179
- [2] **Liu, Z.**, Rumpler, R. and Feng, L., 2019. Investigation on sound transmission through a locally resonant metamaterial cylindrical shell. *Journal of Applied Physics*, 125, 115105(2019). doi: 10.1063/1.5081134
- [3] Song, Y., Feng, L., **Liu, Z.**, Wen, J. and Yu, D., 2019. Suppression of the vibration and sound radiation of a sandwich plate via periodic design. *International Journal of Mechanical Sciences*, 150, pp.744-754. doi: 10.1016/j.ijmecsci.2018.10.055
- [4] **Liu, Z.**, Rumpler, R. and Feng, L., 2018. Broadband locally resonant metamaterial sandwich plate for improved noise insulation in the coincidence region. *Composite Structures*, 200, pp.165-172. doi: 10.1016/j.compstruct.2018.05.033

WORK EXPERIENCE

- School of Materials, Sun Yat-sen University, Guangzhou, China
External researcher
Research on the application of acoustic metamaterials.
SEP. 2020, CURRENT (PT)
- Department of Mechanical Engineering, Tsinghua University, Beijing, China
External researcher
Tribological behaviour of a diesel engine and engine sealing project.
JUL. 2020, CURRENT (PT)
- Institute of Acoustics, Tongji University, Shanghai, China
Research engineer
DEC. 2019, CURRENT (PT)

Modeling the sound insulation performance of the multilayer systems.

JUL. 2019, JAN. 2021 (FT)

Yi Duo Information Technology Co., Ltd. (Shanghai), Shanghai, China
Senior acoustic consultant, Project manager

Develop pipeline jackets for nuclear power plant in order to achieve integrated function of thermal insulation and noise reduction as a part of the National Major Project Research of China.

DEC. 2018 – JUN. 2019 (PT)

KTH Royal Institute of Technology, Stockholm, Sweden
Research engineer

Study the acoustic properties of metamaterials to develop applications in sound insulation engineering; laboratory assistant at Marcus Wallenberg Laboratory for Sound and Vibration Research(MWL).

PROJECT EXPERIENCE

SEP. 2020 – CURRENT

Research on the potential applications of acoustic metamaterials
School of Materials Sun Yat-sen University

Explore the possibility of realizing acoustic metamaterials. Develop the potential applications of acoustic metamaterial.

JUL. 2020 – CURRENT

Tribological behaviour of a diesel engine
Weichai Power Co., Ltd & State Key Laboratory of Tribology, Tsinghua University

Improve the tribological behaviour of a diesel engine by improving its sealing performance.

JUN. 2019 – JAN. 2021

Research on the Noise and Vibration Control of the Pipelines for Nuclear Power Plant
National Science and Technology Major Project. Yi Duo Co., Ltd.; Tongji University & Shanghai Nuclear Engineering Research and Design Institute

NVH control of the pipeline for the nuclear power plant. This project is a part of the National Science and Technology Major Project, under the Project Number ZDo8-212-002-002, funded by China Innovation Funding.

DEC. 2018 – JUN. 2019

Acoustic metamaterials
MWL, AVE, KTH

Investigations on the properties of acoustic metamaterials in order to develop more applications for practical engineering.

SEP. 2016 – MAR. 2019

Design of soundproof panels via metamaterial concept
PhD project at MWL, AVE, KTH

Investigation on the acoustic properties of metamaterial panels, especially with the application to sound insulation.

OCT. 2018 – FEB. 2019

Analysis and design of sandwich structures
Lightweight structures group, AVE, KTH

The project aims at investigating and improving the sound transmission loss properties of sandwich structures. A solution is proposed to the coincidence effect of sandwich structures.

SEP. 2016 – MAR. 2017

Roll2Rail Project
Hitachi Rail Italy & MWL, AVE, KTH

The Roll2Rail project aims to develop key technologies for radical innovation in the field of railway vehicles. As part of this project, Zibo simulated the sound transmission loss property of the cabin of a train under the supervision of Dr. Roman Rumpfer.

SEP. 2015 – JAN. 2016

Acoustic properties of porous materials
MWL, AVE, KTH

The project aims to study the acoustic properties of porous materials. Biot's theory was studied through the project. A theoretical basis

for the core design of the further sandwich structure is provided.

JAN. 2015 – MAY 2015

Structural analysis of GKN driveline

GKN Driveline & MWL, AVE, KTH

The modal analysis of a GKN driveline was carried out. Eigenmodes and eigenfrequencies are predicted theoretically and then tested experimentally.

CONFERENCES

- 2018 JUL. ICSV 2018, Hiroshima, Japan
Oral presentation & published paper
Investigation on the acoustic behaviour of the locally resonant metamaterial curved panel
- 2017 JUN. Acoustics'17, Boston, Massachusetts
Oral presentation & published abstract
Design of broadband acoustic metamaterials for low-frequency noise insulation *JASA*, 141(5), pp.3574-3574.
- 2016 JUN. BNAM 2016, Stockholm, Sweden
Oral presentation & published paper
A finite element model for the vibro-acoustic analysis of plates and sandwich structures
- 2014 DEC. SAPEM 2014, Stockholm, Sweden
Attendance & organizing committee

SEMINARS

- 2019 FEB. AVE KTH, Stockholm, Sweden
Lecture on the acoustic properties of sandwich
- 2018 DEC. ABB, Västerås, Sweden
Introduction to the acoustic metamaterial
- 2017 DEC. MWL Annual, Stockholm, Sweden
Introduction to the research progress
- 2017 DEC. AVE Department Seminar, Stockholm, Sweden
Metamaterial sandwich plate for noise insulation
- 2016 DEC. MWL Annual, Vaxholm, Sweden
Introduction to the research progress
- 2015 DEC. Bombardier Transportation, Västerås, Sweden
Introduction to the research on sound insulation

AWARDS

- 2014 **CSC Scholarship**
China Scholarship Council
- 2011 **Excellent Graduate**
Beijing Institute of Technology

INTERESTS

a) Engineering mathematics and physics; b) Computer science, machine learning; c) Historical and political books/talks; d) Piano, Running.

REFERENCES

Dr. Leping Feng

POSITION Associate Professor
EMPLOYER Department of Aeronautical and Vehicle Engineering
KTH Royal Institute of Technology
EMAIL fengl@kth.se

Dr. Romain Rumpler

POSITION Researcher
EMPLOYER Department of Aeronautical and Vehicle Engineering
KTH Royal Institute of Technology
EMAIL rumpler@kth.se

Dr. Qi Li

POSITION CEO
EMPLOYER Yi Duo Information Technology Co., Ltd.(Shanghai)
EMAIL liqi@yiduo-tech.com

Dr. Wuzhou Yu

POSITION Associate Professor
EMPLOYER Institute of Acoustics, Tongji University
EMAIL ywzh@tongji.edu.cn

Dr. Dameng Liu

POSITION Associate Professor
EMPLOYER Department of Mechanical Engineering, Tsinghua University

Dr. Bin Li

POSITION Professor
EMPLOYER School of Materials, Sun Yat-sen University



EXAMENSBEVIS | DEGREE CERTIFICATE

Teknologie doktorsexamen

inom ämnet farkostteknik

*Degree of Doctor of Philosophy
in the subject area of Vehicle and Maritime Engineering*

Zibo Liu

19890318-3773

Stockholm den 12 april 2019
Stockholm, Sweden 12 April 2019

på rektors vägnar
on behalf of the President

Helena Björk

Examenshandläggare
Degree Officer

Sigbritt Karlsson
rektor, Kungliga Tekniska högskolan, KTH
President, KTH Royal Institute of Technology

Zibo Liu
Namn/Name

19890318-3773
Personnummer/Personal identity number

har i enlighet med bestämmelserna i högskoleförordningen (1993:100) om utbildning på forskarnivå avlagt teknologie doktorsexamen.
I utbildningen ingår utöver kurser att författa och vid en offentlig disputation försvara en vetenskaplig avhandling.
has, in accordance with the Swedish Higher Education Ordinance (1993:100) concerning third-cycle studies, been awarded the Degree of Doctor of Philosophy, having passed the examinations included in the educational programme and publicly defended a scientific thesis.

Kod Code	Kurs Course	Högskolepoäng Credits	Betyg Grade	Datum Date
	SD3145 Mätningar och analys av ljud och vibrationer <i>SD3145 Measurement and Analysis of Sound and Vibration</i>	9,0	Godkänd ¹ Pass	2015-12-07
	SD3140 Signalanalys <i>SD3140 Signal Analysis</i>	5,0	Godkänd ¹ Pass	2016-02-05
	SD3120 Strömningsakustik I <i>SD3120 Flow Acoustics I</i>	6,0	Godkänd ¹ Pass	2016-04-26
	SD2140 Strukturakustik <i>Vibro Acoustics</i>	8,0	Godkänd ¹ Pass	2016-10-04
F1N5113	Vetenskapsteori och forskningsmetodik, teknik- och naturvetenskaplig inriktning <i>Theory of Science and Research Method, Technological and Natural Sciences</i>	7,5 ²	Godkänd ¹ Pass	2017-08-22
FDS3102	Att skriva vetenskapliga artiklar <i>Writing Scientific Articles</i>	5,0	Godkänd ¹ Pass	2017-12-11
FSD3100	Materialakustik I <i>Material Acoustics I</i>	7,5	Godkänd ³ Pass	2019-01-16
FSD3103	Materialakustik III <i>Material Acoustics III</i>	2,5	Godkänd ³ Pass	2019-01-16
FSD3405	Analys och konstruktion av sandwichstrukturer <i>Analysis and Design of Sandwich Structures</i>	10,0	Godkänd ³ Pass	2019-03-20
	Doktorsavhandling <i>Doctoral thesis</i>		Godkänd ¹ Pass	2019-03-27

Avhandlingens titel
Title of thesis

Design of soundproof panels via metamaterial concept
Design of soundproof panels via metamaterial concept

Noter/Notes

- ¹ Betygsskala: Godkänd (G)
Grading scale: Pass (G)
- ² Konverterade högskolepoäng
Converted credits
- ³ Betygsskala: Godkänd (P)
Grading scale: Pass (P)

DIPLOMA SUPPLEMENT

This Diploma Supplement model was developed by the European Commission, Council of Europe and UNESCO/CEPES. The purpose of the supplement is to provide sufficient independent data to improve the international "transparency" and fair academic and professional recognition of qualifications (diplomas, degrees, certificates etc.). It is designed to provide a description of the nature, level, context, content and status of the studies that were pursued and successfully completed by the individual named on the original qualification to which this supplement is appended. It should be free from any value judgements, equivalence statements or suggestions about recognition. Information in all eight sections should be provided. Where information is not provided, an explanation should give the reason why.

1. Information identifying the holder of the qualification

- 1.1 **Family name(s)** Liu
- 1.2 **Given name(s)** Zibo
- 1.3 **Date of birth (day/month/year)** 18 March 1989
- 1.4 **Student identification number or code (if available)** 19890318-3773

2. Information identifying the qualification

- 2.1 **Name of qualification and (if applicable) title conferred (in original language)**
Teknologie doktorsexamen (Degree of Doctor of Philosophy)
- 2.2 **Main field(s) of study for the qualification**
Vehicle and Maritime Engineering
- 2.3 **Name and status of awarding institution (in original language)**
Kungliga Tekniska högskolan (Royal Institute of Technology).

State higher education institution with status of university.

- 2.4 **Name and status of institution (if different from 2.3) administering studies (in original language)**
Not applicable.
- 2.5 **Language(s) of instruction/examination**
Swedish and English.

3. Information on the level of the qualification

- 3.1 **Level of qualification**
Forskarnivå/Third-cycle QF-EHEA SeQF 8/EQF 8. For information on the Swedish higher education system, see section 8.
- 3.2 **Official length of programme**
240 högskolepoäng (credits)/240 ECTS. Duration of 4 years of full-time studies. A normal 40-week academic year corresponds to 60 credits (högskolepoäng). One credit corresponds to 1 ECTS credit.
- 3.3 **Access requirement(s)**
There are general and (additional) specific entry requirements that should be fulfilled for access to higher education within all cycles. The general entry requirements for third-cycle studies are a second-cycle qualification, or completed courses worth at least 240 credits (of which 60 credits are at second-cycle level) or the equivalent level of knowledge acquired in Sweden or abroad. Furthermore, for entry to third-cycle studies, the applicant must be deemed able to benefit from the education.

4. Information on the contents and results gained

- 4.1 **Mode of study**
Full-time equivalent.
- 4.2 **Programme requirements**
The Swedish Higher Education Act takes account of 1) courses and study programmes based on scholarship or artistic practice and on proven experience, and 2) research and artistic research as well as development work. Reference to research below also applies to artistic research.

According to the Swedish Higher Education Act, third-cycle courses and study programmes shall be based fundamentally on the knowledge acquired by students in first- and second-cycle courses and study programmes, or its equivalent. In addition, third-cycle study programmes shall develop the knowledge and skills required to be able to undertake autonomous research. (For further information, see The Swedish Higher Education Act and The Higher Education Degree Ordinance: www.uhr.se/en)

Studies encompass 240 credits. In addition to a scientific dissertation/thesis of at least 120 credits, doctorates include courses of at least 60 credits. The syllabus for the subject may require more credits from the course component. Of the total course component, at least 60 percent must be at third cycle. Courses at undergraduate level within the academic area

of engineering may not be included in this degree. For students with qualifying educational programmes other than the engineering background, deviations may be made from this requirement. Students with such educations may, to a certain extent, utilise courses outside the academic area of engineering as replacements for compulsory courses in the syllabus for the subject. This is to be documented in the student's individual course plan. Additional goals within the framework of the Higher Education Ordinance Degree procedures (HF Annex 2) and the goals stated in this local degree procedure are established by the Faculty Board in the syllabus for the subject at third cycle. For detailed information on programme goals please refer to each syllabus. This degree is entitled Teknologie doktorsexamen (PhD). In individual cases nomenclature other than teknologie may be used. Such decisions are to be taken by the Faculty Board.

4.3 Programme details (e.g. modules or units studied), and the individual grades/marks/credits obtained (if this information is available on an official transcript this should be used here)

A Degree of Doctor is awarded after the third-cycle student has completed a study programme of 240 credits in a subject in which third-cycle teaching is offered.

For the Degree of Doctor the third-cycle student shall have been awarded a pass grade for a research thesis (doctoral thesis) of at least 120 credits.

For more information, see Degree Certificate/Official Transcript.

4.4 Grading scheme and, if available, grade distribution guidance

There is no national grading system in Sweden. Higher education institutions may determine which grading system is to be used. For more information, see Degree Certificate/Official Transcript.

4.5 Overall classification of the qualification (in original language)

Not applicable for Swedish qualifications, since no overall grade is awarded for a degree and students are not ranked. For example, Grade Point Average (GPA) and other ranking systems are not used in Sweden.

5. Information on the function of the qualification

5.1 Access to further study

Not applicable. Doktorsexamen is the highest degree in the Swedish higher education system.

5.2 Professional status (if applicable)

Not applicable.

6. Additional information

6.1 Additional information

The education has been arranged within the PhD programme: Vehicle and Maritime Engineering

6.2 Further information sources

Kungliga Tekniska högskolan, SE-100 44 Stockholm, <http://www.kth.se>

The Swedish Council for Higher Education (Universitets- och högskolerådet) has been commissioned to act as the Swedish NARIC and is also part of ENIC. The ENIC-NARIC office provide information on education in Sweden. Please see: <http://www.uhr.se>

For information on Professional Qualifications Directive, Swedish National Assistance Centre for the Recognition of Professional Qualifications (Professional Qualifications Directive 2005/36/EC): pqinfo@uhr.se

For information on quality assurance, Swedish Higher Education Authority: <http://english.uka.se>

7. Certification of the supplement

7.1 Date 12 April 2019

7.2 Signature

Helena Björk

7.3 Capacity Degree Officer

7.4 Official stamp or seal

Please see 7.2

8. Information on the national higher education system

See attached information on the The Swedish higher education system.

The Swedish higher education system

According to legislation after 1 January 2007.

The following description is approved by the Swedish Council for Higher Education.

The Swedish higher education system is based on the Swedish Higher Education Act (SFS 1992:1434) and the 1 January 2007 amendments to the Higher Education Ordinance (1993:100). The following description is a short summary based on the legislation regulating the Swedish higher education system.

Qualifications from all higher education institutions (universities, university colleges and independent higher education providers) that are recognized by the Government are of equal official value. The same legislation governs all state higher education institutions. All Swedish degrees are issued in accordance with the same degree ordinances.

Quality assurance

The Swedish Higher Education Authority has been responsible for the quality assurance system for all higher education since 1 January 2013. For more information, please visit www.uka.se. Evaluation reports are available to the public.

National Qualification Frameworks

The Swedish Higher Education Act and the Higher Education Ordinance have been amended in accordance with the agreements reached as part of the Bologna Process, including the Qualifications Frameworks in the European Higher Education Area (QF-EHEA). Legislation for a three-cycle structure of higher education started to apply in July 2007, and is now the only one in use in all Swedish higher education. Transitional provisions apply to courses and programmes that started prior to this. For more information, please visit www.uhr.se/en or enic-naric.net.

In 2015, the Swedish Government decided on a national qualifications framework (SeQF), based on the European Qualifications Framework for Lifelong Learning (EQF). The SeQF has eight levels that are in accordance with the EQF

levels. Higher education qualifications are at levels six to eight. For more information, please visit www.seqf.se.

Credit system

Sweden has a system of credits (högskolepoäng); a normal 40-week academic year corresponds to 60 credits. The system is compatible with ECTS credits.

Grading system

There is no national grading system in Sweden. Higher education institutions may determine which grading system is to be used. No overall grade is awarded for a degree and students are not ranked. For example, Grade Point Average (GPA) and other ranking systems are not used in Sweden.

Access and admission

There are general and specific entry requirements for access to higher education within all cycles. The specific entry requirements vary according to the field of higher education and/or should be essential for students to be able to benefit from the course or study programme. The number of places is limited on all study programmes and courses.

The general entry requirements for first-cycle studies are the same for all higher education. General entry requirements can be attained by completing an upper-secondary school programme, via adult education at upper-secondary school level or the applicants achieving a comparable level of learning outcomes through other education, practical experience or other circumstances.

The general entry requirements for second-cycle studies are a first-cycle qualification of at least 180 credits, or a corresponding foreign qualification. An applicant may also be accepted on the basis of a comparable level of learning outcomes obtained through other education, practical experience or other circumstances. →

The general entry requirements for third-cycle studies are a second-cycle qualification, or completed courses worth at least 240 credits (of which 60 credits are at second-cycle level) or the equivalent level of knowledge acquired in Sweden or abroad. Furthermore, for entry to third-cycle studies, the applicant must be deemed able to benefit from the education.

Qualifications

All courses, study programmes and qualifications are on one of three levels: first-, second- or third-cycle. In the Higher Education Ordinance, the Government has determined which qualifications may be awarded, as well as their scope, requirements and intended learning outcomes. There are three categories of qualifications: general; the fine, applied and performing arts; and professional qualifications. For some more information, please see below.

General qualifications

First-cycle (SeQF/EQF 6)

Högskoleexamen (Higher Education Diploma) requires 120 credits and an independent project (degree project).

Kandidatexamen (Degree of Bachelor) requires 180 credits. At least 90 credits must be completed in the main field of study, including an independent project (degree project) worth 15 credits.

Second-cycle (SeQF/EQF 7)

Magisterexamen (Degree of Master (60 credits)) requires 60 credits. At least 30 credits must be completed in the main field of study, including an independent project (degree project) worth 15 credits. In addition, the student must normally hold a *kandidatexamen*, or a professional degree of at least 180 credits, or an equivalent foreign degree.

Masterexamen (Degree of Master (120 credits)) requires 120 credits. At least 60 credits must be completed in the main field of study, including an independent project (degree project) worth at least 30 credits. In addition, the student must normally hold a *kandidatexamen*, or a professional degree of at least 180 credits or an equivalent foreign degree.

Third-cycle (SeQF/EQF 8)

Licentiatexamen (Degree of Licentiate) requires at least 120 credits, including a research thesis worth at least 60 credits. A higher education institution may decide that a *licentiatexamen* can be awarded as a separate qualification or as a step on the way to *doktorsexamen* (see below).

Doktorsexamen (Degree of Doctor) requires 240 credits, including a research thesis (doctoral thesis) worth at least 120 credits. The thesis must be presented at a public defence.

Qualifications in the fine, applied and performing arts

Qualifications in the fine, applied and performing arts are awarded at all three cycles and corresponding SeQF levels. At first-cycle level: *konstnärlig högskoleexamen* (Higher Education Diploma) and *konstnärlig kandidatexamen* (Degree of Bachelor of Fine Arts). At second-cycle level: *konstnärlig magisterexamen* (Degree of Master of Fine Arts (60 credits)) and *konstnärlig masterexamen* (Degree of Master of Fine Arts (120 credits)). Two third-cycle qualifications are awarded: *konstnärlig licentiatexamen* (Degree of Licentiate) and *konstnärlig doktorsexamen* (Degree of Doctor).

Professional qualifications

Professional qualifications are offered at either first- or second-cycle level and corresponding SeQF levels. These qualifications may stretch over two cycles and are awarded in areas that include engineering, health care, agriculture, law, and education. Professional qualifications are regulated by national legislation and are considered regulated education subject to the Professional Qualifications Directive 2005/36/EC.

Titles of qualifications

Translations into English of all titles of qualifications are regulated at the national level. Higher education institutions may decide to add a prefix to a qualification title e.g. *filosofie kandidatexamen* or *medicine doktorsexamen* or/and add a major field of studies e.g. *civilingenjörsexamen i maskinteknik*.