[EmTech]

AA Emergent Technologies & Design Graduate Programme

http://emtech.aaschool.ac.uk/

Course Director
Dr. Elif Erdine

Founding Director
Dr. Michael Weinstock

Studio Tutors
Alican Sungur
Eleana Polychronaki
Abhinav Chaudhary
Lorenzo Santelli

Teaching Assistant
Milad Showkatbakhsh

And our distinguished colleague
Emeritus Professor Dr. George Jeronimidis
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1. INTRODUCTION & OVERVIEW

The Emergent Technologies and Design Programme (inaugurated in 2001) is open to graduates in architecture and engineering who wish to develop skills and pursue knowledge in architectural design science that is located in new production paradigms.

We are continuing to investigate new synergies of architecture and ecology through the critical intersection of computational design and fabrication. Our focus is on exploring experiential and social potentials of new material and spatial configurations for architectural and Ecological Urban Designs situated in the dynamic contexts of emerging biomes. The programme is designed to stimulate critical thinking through experience of research driven design projects that are developed in an intellectually rigorous and creative studio environment. Our projects are pursued by multiple iterations through hypothesis, material and computational experimentation, robotic fabrication, and evaluation; reflected upon in verbal presentations and group discussions, and documented in analytical and scientifically structured papers.

Our Masters (M.Arch./M.Sc.) programme has two distinct phases - the Studio and the Dissertation. Both Studio and the Dissertation are aligned with, and supported by the research of the programme team and the advanced expertise our alumni and research colleagues in practice and industry.

The AA is a Partner Institution and Affiliated Research Centre of The Open University (OU), UK. All taught graduate degrees at the AA are validated by the OU. The OU is the awarding body for research degrees at the AA.

The Studio commences 23 September 2019
Completes on 20 March 2020, Final Submission 20 April 2020

The Dissertation commences 20 April 2020

MSc. Final Presentation 08 September 2020, Final Submission 18 September 2020
M.Arch. Final Presentation 13 January 2021, Final Submission 15 January 2021

Design Research is central to the agendas of Emergent Technologies and Design, and the programme proceeds from the fundamental premise of a shared understanding between staff, students, researchers and collaborators across the world that nature and artifice are strongly coupled, that the cultural production of artefacts and systems exist as part of the environment of other active systems, and that they are subject to change. They also share an understanding that causality of change is complex and multi-scalar, that the dynamics of change are perturbed and accelerated by human activities, and they share a concern for the consequences of those changes to society and the natural world. Design processes in this domain are developed through iterative computational processes of serial experimentation and analysis, generative propositions and simulations. The programme is structured to provide skills and knowledge of a coherent set of linked and convergent discourses, methodologies and concerns that cross multiple disciplines in The Studio, and the opportunity to further develop those skills and deepen knowledge in the Dissertation.

The Studio comprises workshops, seminars design projects that are led by EmTech staff and our associated researchers, and offers a creative and intellectually rigorous sequence of study that builds knowledge and skill. It provides an intensive engagement in Design Science and introduces our students to the wider community of design researchers in London practices. It concludes with guiding students through the formation of a detailed proposal for an original architectural inquiry that is to be pursued in the Dissertation.
The Dissertation Research Studio extends the acquisition of research competencies through extensive collaborative dialogue with EmTech’s research community of active Post Doc researchers and PhD candidates. There are two main fields of Design Research in which we are active: Dynamic Material Systems with Advanced Fabrication including robotic techniques, and Ecological Urban Design in emergent biomes.

Students integrate explorations of the theoretical discourses, relevant sciences and case studies of ‘state of the art’ projects in the domain of their chosen topic, and set out the methods and protocols for the development of their Design Proposal. The development and conclusion of the final proposal is pursued through the iterative design cycles in which students have acquired knowledge and skills during the early phases of the programme.

Design & Build is our ‘extracurricular’ collaborative student project, and is an essential part of the pedagogy and culture of EmTech. It runs right through the year, alongside both Studio and the Dissertation, and provides opportunities to design and deliver a built project with real material, structural, fabrication and assembly constraints. The experience gained enhances the design, computational and analytical skills students have acquired in Studio, and it develops crucial transferrable skills that are applicable to professional practice. Our Design & Build projects have been published internationally in the architectural press since 2001, and have received industry awards.

Staff

Dr. Elif Erdine, Director is an Architect and Researcher. Her PhD thesis (2015) focused on the integration of tower subsystems through generative design methodologies informed by biomimetic analogies. Since 2010 she has been teaching and coordinating various AA Visiting School programmes. Her research interest lies in the integration of computational design, geometry rationalization, material behaviour, and robotic fabrication techniques.

Dr. Michael Weinstock, Founding Director is an Architect and Researcher who studied at the AA and has taught at the AA since 1989. His research interest lies in exploring the convergence of the natural sciences with architecture. He received the Acadia Award for Excellence 2008, and is a Fellow of the Royal Society of the Arts. He has an extensive body of published work, including “The Architecture of Emergence: the Evolution of Form in Nature and Civilisation” and “Emergent Technologies and Design - Towards a Biological Paradigm for Architecture”.

Alican Sungur, Studio Tutor is currently a Computational Designer at Pattern Design. His main focus is on performance oriented architecture through modelling and manufacturing complex geometries, and on spatial, environmental and structural analysis methods. He is a graduate of Emergent Technologies and Design Programme (2016, Distinction).

Eleana Polychronaki, Studio Tutor an Architect and Computational Designer. She holds a Diploma in Architecture and Engineering from the N.T.U.A Athens and an MSc in Emergent Technologies and Design from the AA, awarded with distinction. She is currently employed as a Computational Design Specialist in Grimshaw.

Abhinav Chaudhary, Studio Tutor is an architect and musician from New Delhi, India currently employed at PLP Architecture in London as a Computational Design specialist. His work focuses on developing AR/VR and geometry optimisation tools for use over various scales of building design and construction.

Lorenzo Santelli, Studio Tutor is a chartered architect and structural engineer. Since he graduated from EmTech in 2015, he has been part of Eckersley O’Callaghan’s Structural Glass Team, Digital Design Group and Glass Technology Group.

Milad Showkatbakhsh, Teaching Assistant is a PhD candidate at Architectural Association researching under the directorship of Dr. Michael Weinstock.
THE STUDIO - FINAL SUBMISSION
(Phase 1 completion)
Individual Final Submission:
20 April 2020

THE STUDIO
(Phase 1 commencement)
Starts on:
23 September 2019

Induction (Boot Camp)
Submission:
21 October 2019

The Scientific Method &
Design Research
Master Class Lecture
Series
Design & Technology
Submission:
18 November 2019

Natural Systems &
Biomimetics
Submission:
02 December 2019

Computation workshops
Advanced Computation /
Simulation workshops
Thesis Formation
Dissertation Proposal extended

Design I
Digital & Material Fabrication
Submission:
06 January 2020

Design II
Ecological Urban Design
Submission:
16 March 2020

THE DISSERTATION
(Phase 2 commencement)
Starts on:
20 April 2020

Research Studio
Design Development

M.Sc. Final Presentation
08 September 2020, MSc. Final Submission: 18 September 2020

MArch. Final Presentation
13 January 2021 March. Final Submission: 15 January 2021

M.Sc. and M.Arch. Dissertation

Evolutionary Computation
(Emergence)
Submission:
10 February 2020

Seminars
(Submission)
Dissertation Development
Lectures / Seminars
(No submission)
Computation sessions

M.Arch. Dissertation

Emergent Technologies and Design
YEAR

YEAR

YEAR

Term 3
M.Sc - M.Arch.

M.Sc. and M.Arch. Dissertation

The Dissertation

Design & Build

M.Sc. and M.Arch. Dissertation
2. TEACHING STAFF

ELIF ERDINE, PHD, M.ARCH., B.ARCH.
Director, Emergent Technologies and Design, AA Graduate School
Programme Head, AA Summer DLAB
Programme Head, AA Istanbul Visiting School

Professional qualification: Registered architect in Turkey.

Elif Erdine is an architect and researcher. During 2010-2015, she conducted her PhD at the Architectural Association PhD in Design Programme, titled ‘Generative Processes in Tower Design: Algorithms for the Integration of Tower Subsystems’, under the advisory of Dr. George Jeronimidis, Dr. Michael Weinstock, and Patrik Schumacher. Since 2010 she has been directing various AA Visiting School programmes (AA Istanbul VS, AA Summer DLAB), exploring generative design techniques, integration of algorithmic design methods with large-scale digital fabrication tools. She has worked for Zaha Hadid Architects during 2006 - 2010. She received her B.Arch. degree from Istanbul Technical University in 2003 (High Honors), and M.Arch. degree from the AA Design Research Lab (AA DRL) in 2006 (Project Distinction).

Research Interests:
Elif Erdine's interests are the integration of algorithmic generative design with large-scale digital fabrication tools, and robotic fabrication techniques. Her PhD thesis has focused on developing a generative system of design that offers simultaneous integration and differentiation throughout the subsystems of a concept for a tall building during the conceptual design phase. Her wider research interests include biomimicry, complex adaptive systems, and robotic fabrication.

Publications:


Symposia & Lectures:

Installations and Constructions:

Exhibitions:
2009. AAST Advanced Architecture Settimo Tokyo, Italy.
2006. Computational Turn of Architecture, Marseille, France.
2006. The Second Architectural Biennial-Beijing, Beijing, China.

MICHAEL WEINSTOCK, PHD, RIBA, FRSA
Director of Studies, AA PhD Programme, AA Graduate School
Founding Director, Emergent Technologies and Design Masters programme, AA Graduate School

Professional qualification: RIBA Chartered Architect

Michael Weinstock studied Architecture at the Architectural Association and has taught at the AA School of Architecture since 1989 in a range of positions from workshop to through Academic Head. He received the Acadia Award for Excellence 2008. Whilst his principal research and teaching has been conducted at the Architectural Association, he has published and lectured widely, and taught seminar courses, studios and workshops on Emergence and associated topics at many other schools of Architecture, in Europe including Delft, Rome, Barcelona, Vienna and in Stuttgart; and in the US at Yale and Rice. He has been Honorary Chief Academic Adviser to the International Research Centre of Computational Design, Tsinghua University Beijing/The University of Hong Kong.

Research Interests:
Michael’s published research has been in the dynamics, forms and energy transactions of natural systems, and the abstraction and systematisation of knowledge of biological morphogenesis and evolution to contribute to innovative computational processes of architectural design and materialisation that are necessary to sustain human societies through the impending changes. His current focus is on defining new models of ecological intelligence for future cities in a changed world with a special focus on developing new paradigms for sentient cities in extreme climates and ecological contexts. The ambition is to develop new paradigms for intelligent cities and settlements in the emergent climates, cultures and ecological contexts of the future, concentrating on deserts, salt marshes and wetlands, and on the tundra.

Publications:


Symposia:
2015, RIBA Commission ‘Design through Production’ - RIBA partnered with the Institute of Materials, Minerals and Mining (IOM3) to deliver a series of conferences on the topic of Design through Production in UK Schools of Architecture. Each conference comprised lectures and debates, with lectures by Michael Weinstock, Wolf Mangelsdorf – Director and Partner of Buro Happold, Manja Van de Worp of Nous Engineering and invited guest speakers from the host Institutions:- University of Bath, Westminster University, South Bank University, Cardiff University, University of Huddersfield, Northumbria University, University of Dundee

Installations and Constructions:
2015, Twist Pavilion, Directed collaboration with Hanson Plywood and TRADA. Pavilion fabricated, constructed and exhibited at Timber Expo, Birmingham, U.K.
2012, AA/ ETH Pavilion, Directed collaboration with the Chair of Structural Design at the Swiss Federal Institute of Technology (ETH), Zurich. Pavilion fabricated, constructed and exhibited at ETH, Zurich, Switzerland.
PROFESSOR GEORGE JERONIMIDIS
Director of Studies, PhD programme, AA Graduate School
Emeritus Professor, Emergent Technologies and Design Masters programme, AA Graduate School

Professor Jeronimidis completed his Doctorate in Physical Chemistry at the University of Rome in 1969. Current research interests cover the application to architecture of mechanics of wood and composite materials and structures, smart materials and structures, bio-inspired composite solutions, plant and animal biomechanics. He has published extensively in these fields contributing research papers in refereed journals, conference proceedings and book contributions. He is Emeritus Professor of Composite Materials Engineering at the University of Reading, Visiting Professor at Dipartimento di Architettura ed Urbanistica, Politecnico di Bari, Italy, and Visiting Professor at Department of Mechanical Engineering, Zhengzhou University, China.

Research Interests:
Professor Jeronimidis has a particular interest the design of composite fibrous structures in biology engineering and architecture to achieve high levels of functional integration. This has generated many collaborative research projects with partners in Europe and the USA, provided funding from various public and industrial sponsors. Professor Jeronimidis is author or co-author of more than 100 papers, conference proceedings and book contributions in the fields of biomechanics, biomimetics, wood science, composite mechanics, smart materials and structures and bio-inspired technologies for architecture.

Grant funded research activities has come from EPSRC, BBSRC, DTI, EU-framework programmes (FP5, FP6), Eureka, DERA, European Space Agency, MOD, US Office of Naval Research, USAF and various UK and overseas private companies.

Current European and International research activities:
2009-Present- President of BIOKON International (from 2009), a European Network for the promotion of Biomimetics in relevant sectors - engineering, architecture, built environment, materials, sensors.

2005-Present - Fellow of the International Academy of Wood Science and Chairman of the Academy Board of the IAWS (2010-2012).

Member of the Scientific Advisory Board for EU-funded Robosoft Coordination Action on Soft Robotics

Nominated Reviewer by the EU-Horizon 2020-FET Research Programme for the project LiNaBioFluid on bio-inspired solutions for micro-fluidic transport

Editorial Board of the international journal “Journal of Biomimetics in Engineering”

Portuguese Department of Higher Education evaluator PhD Materials Science Programme at the Universidade Atlantica and a Masters Programme at the Univerity of Aveiro

Publications:
2016, Guilder, J. and Jeronimidis, G. ‘A design analysis approach towards bio-inspired smart material applications for architecture’, Proceedings of Build Skins Conference, Bern, Switzerland


Symposia:
In addition to the above research information, Professor Jeronimidis has given many Keynote and Invited Lectures on his research interests at various international conferences in Europe, the USA, Japan and New Zealand and also been involved in the Scientific and Organizing Committees of several International Conferences.

ALICAN SUNGUR
Studio Tutor, Emergent Technologies and Design, AA Graduate School

Professional qualification: Registered architect in Turkey; RIBA Part II Equivalent.

Alican Sungur is an architect and researcher. He holds a MArch degree from the AA, Emtech studio and a BArch degree from METU. He is specialised in analysis driven design, computational tool making and complex modelling. His current research interest is focused on dynamic systems and its potential to be used in digital fabrication and urban design. Alican has taught at the Oxford Brookes University, and the Architectural Association where he is currently a studio tutor at Emtech Studio. He has won awards in national and international architecture competitions. After he worked
at design of the two Qatar 2022 world cup stadiums at Pattern Architects in London. Currently, he is working for WilkinsonEyre.

**Research Interests:**
He is specialised in analysis driven design, computational tool making and complex modelling.

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**ELEANA POLYCHRONAKI**
Studio Tutor, Emergent Technologies and Design, AA Graduate School

Eleana Polychronaki is an Architect and Computational Designer. She holds a Diploma in Architecture and Engineering from the N.T.U.A Athens and an MSc in Emergent Technologies and Design from the AA, awarded with distinction. She is currently employed as a Computational Design Specialist in Grimshaw, focusing on enabling the design and analysis of complex geometries, as well as actively developing a series of in-house computational tools and workflows. Prior to her position as tutor in the AA, she has led a number of workshops around AR and VR technologies and has worked as a research collaborator in the project “Healthy Housing for the Displaced” carried out by the University of Bath and the EPSRC. She has a keen interest in participatory design, the concept of spatial perception and how these can be pursued through immersive technologies. Her research has been published in SimAUD, BRI and CoDesign among others.

**ABHINAV CHAUDHARY**
Studio Tutor, Emergent Technologies and Design, AA Graduate School

Abhinav Chaudhary is an architect and musician from New Delhi, India currently employed at PLP Architecture in London as a Computational Design specialist. His work focuses on developing AR/VR and geometry optimisation tools for use over various scales of building design and construction. He has previously worked at Orproject (Delhi, London, Beijing) on a number of award winning and published installations and pavilions. He received B. Arch from Sushant School of Art and Architecture in 2011 and M. Arch with distinction from AA Emergent Technologies and Design (EmTech) in 2019.

**LORENZO SANTELLI**
Studio Tutor, Emergent Technologies and Design, AA Graduate School

Lorenzo Santelli is a charted architect and structural engineer. Since he graduated from EmTech in 2015, he has been part of Eckersley O’Callaghan’s Structural Glass Team, Digital Design Group and Glass Technology Group. He developed expertise in geometrically complex structures, structural analysis and parametric design. He is currently working on glass, steel, cable and carbon fibre structures for building and marine applications based in Europe and Asia. His experience also benefits from long construction site supervision roles. Lorenzo graduated in Architecture and Construction Engineering from the University of Pisa and obtained the licences to practice engineering and architecture both in Italy and the United Kingdom.
time frame: June 1-30
6:00am - 18:00pm
360 hours in total

density level: 5
surface area: 6.48%
sunlight hour: 360 hours
3. EXTERNAL RELATIONS

We have a solid foundation in the external relations developed by Dr. Michael Weinstock and the teaching faculty of the Emergent Technologies and Design Programme since 2000, and from the two decade-long association of the Undergraduate School Technical Studies with leading engineering practices.

3.1 Past and Present Relations
Relationships have been established between the Emergent Technologies and Design programme and:

Arup, London
Buro Happold, London
Centre for Biomimetics, Reading University, Reading, UK
Institute for Computational Design, University of Stuttgart, Stuttgart, Germany
Chair of Structural Design, Swiss Institute of Technology (ETH), Zurich, Switzerland
Faculty of Environmental Design, University of Calgary, Canada
Institute of Building Structures and Structural Design, Stuttgart University, Stuttgart, Germany
Timber Research and Development Association, High Wycombe, UK
Hanson Plywood, Halifax, UK
Manchester School of Architecture, University of Manchester, Manchester, UK
California College of the Arts, San Francisco, USA
ELISAVA, Barcelona, Spain
Institute of Advanced Architecture of Catalunya, Barcelona, Spain
Automata Technologies, London, UK
ITECH, University of Stuttgart, Stuttgart, Germany
RWTH Aachen University, Aachen, Germany
AKT II, London, UK
EZCT, Paris, France
Manchester School of Architecture, Manchester, UK
Knippers Helbig Advanced Engineering, Stuttgart, Germany
The Living, New York, USA
SOM, USA
Hoberman Associates, USA
Harvard University City Form Lab, USA

3.2 Alumni Employment
EmTech graduates take on various opportunities after finishing the course. Some graduates go on to teach at the AA and other schools internationally. Others go on to work at many exciting offices in London and around the world. Recent employers include: Foster + Partners (London), KPF (London), Heatherwick Studio (London), Grimshaw Architects (London), Robofold (London), Zaha Hadid Architects (London), Buro Happold (London), AKT II (London), OMA (Rotterdam), UN Studio (Amsterdam), Wilkinson Eyre Architects (London), Ron Arad Associates (London), AHMM (London), Arup (London), PLP Architecture (London), Coop Himmelblau (Vienna), AECOM (London), Populous (London), Pattern Architects (London), SOM (London), SHoP Architects (New York) amongst others.
3.3 Visiting Instructors and Guest Critics
Each year EmTech invites Visiting Instructors to lead workshops and assist in seminar and studio sessions. Visiting Instructors for last year included:

Jens Pedersen, Aalborg University
Sean Hanna, UCL Bartlett
Daghan Cam, Al Build
Claudio Campanile & Diego Valdivia Luque, Bryden Wood
Nicolo Bencini, BuroHappold
Henrik Jeldtoft Jensen, Centre for Complexity Science - Imperial College London

Our guest critics for the previous year have included:

Andy Watts, Grimshaw
Al Fisher, BuroHappold
Francis Aish, Foster + Partners
Lars Hesselgren, PLP Architecture
Camila Rock De Luigi, Grimshaw
Spyros Efthymiou, AKT II
Nicolo Bencini, Buro Happold Engineering
Mike Cook, Buro Happold Engineering
Eduardo Rico, Architectural Association
Giulio Gianni, AKT II
4. PROGRAMME SPECIFICATION

EMERGENT TECHNOLOGIES AND DESIGN 2019-20

Degrees:
Post-professional Master of Science (M.Sc.)
Post-professional Master of Architecture (M.Arch.)
180 Credits - M.Sc and M.Arch. run concurrently, students select one or the other prior to entry.

Duration:
M.Sc. 23 September 2019 through to 18 September 2020
M.Arch. 23 September 2019 through to 15 January 2021

Mode of Study: Full-time

Course Director: Dr. Elif Erdine
Founding Director: Dr. Michael Weinstock

Staff and their roles:
Studio Tutors: Alican Sungur, Eleana Polychronaki, Abhinav Chaudhary, Lorenzo Santelli

External Examiners:
Dr. Wasim Jabi, Senior Lecturer, Welsh School of Architecture, Cardiff University;
Dr. Mike Cook, Chairman/Senior Partner, Buro Happold

Entry Requirements:
Entry for M.Sc is open to students who have graduated in Architecture or Engineering.
Entry for M.Arch is open to students who have graduated in Architecture.

Course Structure:
The Programme consists of two phases:
The Studio (Phase 1) 80 Credits – 45%
(M.Sc. and M.Arch. students undertake the same Studio and work together.)
The Dissertation (Phase 2) 100 Credits – 55%

Requirements for the award of Degree:
M.Sc.: The successful completion of the Studio (Phase 1) and successful completion of the M.Sc. Dissertation (Phase 2)

The M.Sc. Dissertation is required to demonstrate the capacity to apply the acquired knowledge and techniques in a creative and innovative way to a material prototype, to the system in which it is embedded, to its fabrications and assembly, and that is developed and evaluated within the context of a climatic or ecological set of parameters.

M.Arch.: The successful completion of the Studio (Phase 1) and successful completion of the M.Arch. Dissertation (Phase 2).

The M.Arch. Dissertation is required to demonstrate the capacity to apply the acquired knowledge and techniques in a creative and innovative way to a set of architectural or urban forms that are developed within an ecological system, to a resolution sufficient to evaluate and refine the system level processes and performances central to the research questions.
Criteria for Final assessments of the M.Sc. and the M.Arch. degrees:
1. The demonstration of clear and appropriate formulations of hypotheses and arguments, and the ability to deploy these in the planning and pursuit of an original and creative research agenda in the field of Emergent Technologies.
2. The demonstration of the ability to conduct critical and technical analysis and produce meaningful results.
3. The demonstration of judgement in the application of research knowledge in a creative and innovative manner to comprehensive digital and physical design experiments and design development.
4. The demonstration of the development of critical faculties and advanced skills in the development and evaluation of detailed and complex design proposals.
5. The demonstration of the capacity to deal with complex research and design issues systematically and creatively, individually and as part of a group.
6. The demonstration of the capacity for precise and clearly structured writing and diagramming with referencing using established and appropriate conventions, and the ability to communicate clearly.
5. AIMS AND LEARNING OUTCOMES

5.1 Programme Aims
The programme is designed to build skills, knowledge and to stimulate critical thinking through the experience of research driven design projects that are developed in an intellectually rigorous and creative studio environment. Our projects are pursued by multiple iterations through hypothesis, material and computational experimentation, robotic fabrication, and evaluation; reflected upon in verbal presentations and group discussions, and documented in analytical and scientifically structured papers.

5.2 Learning Outcomes

Knowledge and Understanding
Assimilation of the programme material and familiarity with concepts, techniques, and strategies in the field of Emergence.

Assimilation and familiarity with material processes and advanced manufacturing techniques.

Assimilation and familiarity with advanced digital and mathematical design techniques.

Assimilation and familiarity with advanced digital structural and environmental analysis.

Specific Skills and Attributes
Demonstration of clear and appropriate formulation of hypotheses and arguments, and the ability to deploy these for the planning and pursuit of a research agenda.

The ability to conduct comparative analysis and produce meaningful generalization.

Demonstration of clear structure, precise writing and presentation of work; referencing of sources, information using agreed conventions.

The development of critical faculties and advanced design skills.

Demonstration of judgment and appropriate application of research material and technical knowledge to design and material experiments.

Demonstration of capacity to apply acquired knowledge and techniques in a creative and innovative way to a comprehensive architectural design and to its material construction.

Demonstration of capacity to apply the acquired knowledge and techniques in a creative and innovative way to a general architectural construction type and material system, or to a developed and tested generative strategy of architectural design.

Transferrable Attributes
A thorough knowledge of the specific concepts, techniques and practices in the field of Emergent Technologies and their effect on the production of built architectures and artefacts.

Capacity for critical and technical analysis.

The ability to construct Case Studies by applying critical and technical analysis to historical modes of construction.

The ability to connect analysis to design philosophies and material strategies and relate them to industrial processes and production.
Skills in developing and pursuing architectural and technical research in the field of Emergent Technologies, and in presenting research findings individually and as part of a group.

The ability to contribute to interdisciplinary professional teams.

### 5.3 MArch Dissertation

The M.Arch. Dissertation is required to demonstrate the capacity to apply the acquired knowledge and techniques in a creative and innovative way to a set of architectural or urban forms that are developed within an ecological system, to a resolution sufficient to evaluate and refine the system level processes and performances central to the research questions.

### 5.4 MSc Dissertation

The M.Sc. Dissertation is required to demonstrate the capacity to apply the acquired knowledge and techniques in a creative and innovative way to a material prototype, to the system in which it is embedded, to its fabrications and assembly, and that is developed and evaluated within the context of a climatic or ecological set of parameters.

### 5.5 Curriculum Map

The Curriculum Map shows how learning outcomes are deployed across the entire study programme. It relates the delivery and assessment of the learning outcomes listed above to the different inputs and outputs of the programme.

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**Knowledge and Understanding**

- Assimilation of the programme material and familiarity with concepts, techniques, and strategies in the field of Emergence
- Assimilation and familiarity with material processes and advanced manufacturing techniques
- Assimilation and familiarity with advanced digital and mathematical design techniques
- Assimilation and familiarity with advanced digital structural and environmental analysis

**Specific Skills and Attributes**

- Demonstration of clear and appropriate formulation of hypotheses and arguments, and the ability to deploy these for the planning and pursuit of a research agenda
- The ability to conduct comparative analysis and produce meaningful generalisation
- Demonstration of clear structure, precise writing and presentation of work; referencing of sources information using agreed conventions
- The development of critical faculties and advanced design skills
- Demonstration of judgement and appropriate application of research material and technical knowledge to design and material experiments
- Demonstrate the capacity to apply acquired knowledge and techniques in a creative and innovative way to a comprehensive architectural design and to its material construction
- Demonstrate the capacity to apply the acquired knowledge and techniques in a creative and innovative way to a general architectural construction type and material system, or to a developed and tested generative strategy of architectural design

**Transferrable Attributes**

- A thorough knowledge of the specific concepts, techniques and practices in the field of Emergent Technologies and their effect on the productino of built architectures and artefacts
- Capacity for critical and technical analysis
- The ability to construct Case Studies by applying critical and technical analysis to historical modes of construction
- The ability to connect analysis to design philosophies and material strategies, and relate them to industrial processes and production
- Skills in developing and pursuing architectural and technical research in the field of Emergent Technologies, and in presenting research findings individually and as part of a group
- The ability to contribute to interdisciplinary professional teams
6. PROGRAMME STRUCTURE

M.Arch. and M.Sc.
Phase 1 - 45% of total credits
Phase 2 – 55% of total credits

The programme has two distinct phases - the Studio and the Dissertation. Both Studio and the Dissertation are aligned with, and supported by the research of the programme team and the advanced expertise our alumni and research colleagues in practice and industry.

Phase 1 (The Studio) commences 23 September 2019
Completes on 20 March 2020 with Final Submission 20 April 2020
Phase 2 (The Dissertation) commences 20 April 2020

The MSc. completes with Final Presentation on 08 September 2020, and Submission of the Dissertation on 18 September 2020.


The Studio - 80 Credits

Design & Technology – 10 Credits
Design I: Digital & Material Fabrication - 20 Credits
Design II: Ecological Urban Design - 20 Credits
Seminar I: Natural Systems & Biomimetics - 15 Credits
Seminar II: Emergence & Evolutionary Computation - 15 Credits

The Dissertation - 100 Credits
PHASE 1: THE STUDIO

The Studio is structured by Workshops, Seminar courses with experimentation, and Design projects that are led by Emtech staff and our associated researchers, and together offer a creative and intellectually rigorous sequence of study that builds knowledge and skill. It provides an intensive engagement in Design Science and introduces our students to the wider community of design researchers in London practices. It concludes with guiding students through the formation of a detailed proposal for an original architectural inquiry that is to be pursued in the Dissertation.

WORKSHOPS:
Induction - The Boot Camp
The Scientific Method and Design Research
Design & Technology
Computation & Advanced Computation and Simulation

Induction - The Boot Camp
This 2-week workshop presents a comprehensive introduction to the core skills and techniques in algorithmic thinking, geometry, digital design and fabrication. It will be centred on the development of associative geometric models in Grasshopper, and the relations between digital morphogenesis and material realization. Students will become familiar with the necessary exchange of data between the digital and physical realm through the formalization of the inherent geometric relationships in all different elements of the developed designs. The course will be supplemented with seminars and tutorials on parametric logic, geometry and material systems and on the appropriate techniques for recording, describing and documenting digital and physical experiments. The Induction Studio will conclude with fabricated and digitally modelled material systems that resolve problems of parametric control, material behaviour, structural integrity, tessellations of three dimensional components, precise dimensional control and spatial organization.

Preparatory Reading


Submission Date: 21 October 2019 (Monday, Week 5, Term 1)

The Scientific Method and Design Research (Elective Course open to Diploma Students)
Michael Weinstock + two invited guest researchers
Term(s) 1
Meeting times Tuesdays at 2.00 -3.30, 8 sessions in Term 1, weeks 3, 4, 5, 6, 7,8, 9, 10; Estimated number of places available to Diploma students: 3

The Scientific Method is an evolving set of procedures based on systematic observations and
measurements, the formulation of ideas (hypotheses), and predictions from those observations that are tested by experiment, the subsequent modification of hypotheses and further experimentation until there is no distance between the hypothesis, predictions and observed results from the experiment.

Design Research is a unique class of enquiry that may include some combination from the larger set of principles of form and behaviour, integrated knowledge from the natural or cultural sciences, a specified degree of mutability such as a relational model capable of adaptation to differing circumstances or environments, testable propositions and principles of implementation, and an expository design (conceptual, physical or computationally simulated) to be used for testing and evaluation. Seminar presentations and discussions are recommended for PhD and Graduate students, and are open to all students.

There are 8 seminars in the series, all taking place in Term 1.

1. The Scientific Method and Design Science
   Hypothesis, Theory, Law, Model, Evidence (experimental/empirical), Quantitative and Qualitative and Mixed methods, Reasoning (logic and styles of arguments) - Inductive, Deductive and Adductive
3. History of Design Science
4. A Design Science research projects (PhD level) - anatomy, methods and models
5, 6, 7, and 8. Invited guests to present a funded (design science) and completed research project and an exegesis of its documentation.

Preparatory Reading


Design & Technology
Design & Technology seminar builds on the techniques and methods explored in Boot Camp to develop proposals with advanced computational design, analysis, and fabrication strategies. It aims to engage analytical tools as methods for generative design, explores a variety of computational workflows, and includes seminars and hands-on workshops in the exploration of scientific methods applied to architectural design research, concentrating on experimentation, analysis, evaluation and decision-making processes.

A range of computational form-finding and analysis methods are going to be introduced alongside the induction of Python programming and advanced digital fabrication techniques. Associations between the digital process of design and the physical world of fabrication and materiality are going to drive the experimentation and analysis stages. Initial experiments conducted by each design team will conclude with a working prototype of their design proposal. A combination of structural, morphological, and performance-related parameters are going to be incorporated in the final prototypes through material and geometrical differentiation.

Areas of investigation include:
Python Programming
Structural Analysis
Environmental Analysis
Computational Fluid Dynamics (CFD)
Emergence / Evolutionary Computation
Document Submission (Team): The document presents the aims of the design experiments, the logics and processes developed and the analysis of their properties and performance in relation to Design & Technology. The relationships between mathematical models and physical prototyping are interrogated, and computational models are used to discover material-driven and geometrical interdependencies. The developed computational workflows are used to explore a family of possible outcomes that are analysed and evaluated based on chosen criteria. Correlations between initial physical experiments and computational models are formulated to provide feedback between digital and physical domains. The team dossier includes a critical account of the experiments, their rationale, computational and analytical models, and the physical prototype.

Learning Outcomes:
1. Understanding of materials/material processes, modelling and digital fabrication techniques.
2. Development of experimental method and strategies in physical and digital experiments.
3. Demonstration of the capacity to apply acquired knowledge and techniques in a creative and innovative way to a material system, its fabrication and assembly processes.
4. Assimilation and familiarity with advanced digital and mathematic design techniques.
5. Assimilation and familiarity with advanced digital structural and environmental analysis.
6. A thorough knowledge of the specific concepts, techniques and practices in the field of Emergent Technologies and their effects on the production of built architectures and artefacts.
7. The ability to connect analysis to design philosophies and material strategies, and relate them to processes of production.

Assessment Criteria:
1. The demonstration of an understanding of the concepts, strategies and analytical tools of Design & Technology.
2. The demonstration of knowledge and skills of geometrical and topological analysis, digital morphogenesis and computational design processes, material behaviour, digital fabrication techniques and assembly processes, and the appropriate deployment of that knowledge and skills in an integrated process.
3. The demonstration of judgement in the deployment of knowledge and skills, and the ability to place these in an appropriate theoretical context.
4. The demonstration of a clear structure and organisation for the presentation of work, and the ability to plan, develop and present comprehensive and precise documentation.
5. The demonstration of skill and judgement in the unfolding of a critical argument with evidence gained from experiments, and the skill to place this in the theoretical context of Design Science.

Preparatory Reading


Submission Date: 18 November 2019 (Monday, Week 9, Term 1)
SEMINAR COURSES:
Natural Systems and Biomimetics
Emergence and Evolutionary Computation

The Seminar Courses include theoretical seminars session and Design experimentation sessions with critical commentary and studio discussions, interleaved with extended technical tutorial support sessions.

Students work in teams of two, and make short group presentations that will include reflections on knowledge gained from the course material, their own experiments, and from their independent research.

The tutorials, discussions and critiques help students to develop the final team submission that includes detailed documentation of their research, experimentation, analysis and critical reflection. The team assembles and produces a coherent research dossier that documents the experiments undertaken by the team, with full data sets of the generative and analytical results. The rationales for the initiating strategies, parameters and processes are to be set out clearly, the argumentation presented for revisions and adjustments made presented, and a review of the outputs, successes and limitations is to be discussed.

Each Individual student also submits a personal essay that situates their work in the relevant research domain and critically reflects upon the achievements and limitations.

Natural Systems and Biomimetics Seminar Course
Dr. Michael Weinstock with Dr. Elif Erdine, Alican Sungur, Eleana Polychronaki, and Abhinav Chaudhary

The course aims to develop an understanding of how biology can be a model for material, mechanical, spatial and computational systems. An introduction to the ways in which organisms have evolved through form, materials and structures in response to varied functions and environments is followed by an account of engineering, logical and organisational design principles that have been abstracted from nature in current research projects for industry and material science. A study is made of a natural system (general form, anatomy, energy flows, geometry, organisation, hierarchies and behaviour), along with an exploration of interrelations and an abstraction of design principles. The methods of analysis as well as system logics and material performance studied in this seminar will be further developed within Design I. Student groups will investigate mathematic, geometric, material and hierarchical logics to develop a critical view on the relationships between systems design and performance. The areas of investigation will formulate the second series of a three-year research agenda on innovative solutions that aim to devise analytical computational approaches through the study of social insect behaviour.

The study of social insects is broad and interdisciplinary; interesting directions include behavioural ecology with advanced molecular biology and computer technology. We will investigate the influences of external and internal stimuli at the level of a group or an individual, identify social hierarchies, explore factors that influence decision-making in a community, identify the parametric variables of a system, and develop a set of rules for computational applications.

Many living forms extend their metabolism by a material construction that reduces the load or stress on some aspects of their metabolic processes. Insect colonies have highly structured social organisations, with restricted reproductive roles for individuals, generations that overlap in time, collaborative care of the offspring, and in many cases morphological distinction or castes for specialised roles. The material forms of the constructions of social insects are spatially complex and exhibit collective metabolic processes that are dynamically regulated to a very fine degree over time.

Document Submission (Team): The document presents the aims of the design experiments, the logics and processes developed and the analysis of their properties and performance in relation to Biomimetics. The relationships between morphological models and mathematical models.
are interrogated, and parametric models will be used to discover material, geometrical, logical, computational and scaling limits of the abstracted systems. The developed parametric models are used to explore a family of possible outcomes and each individual will be analysed and evaluated based on chosen criteria. The team dossier includes a critical account of the experiments, their rationale and context, and a set of physical, computational and analytical models. It is expected that the document clearly presents observations and critical reflection of the experiments.

Document Submission (Individual): An individual 2,500-word critical essay is to be submitted that explores aspects covered in the seminar course. This essay should reflect on the theoretical and conceptual framework of biology as a model for architectural design and relate the work undertaken throughout the seminar to relevant references. Course material including compiled abstracts, readers and reading lists provide a starting point, but it should be noted that the submission is intended to extend beyond the limit of public domain information. Students are expected to research across several different disciplines. The document reflects upon the personal skills and knowledge gained and how they can be further developed in the future, together with a commentary on their participation and contribution to the team and the results.

Course Sessions
Stage 1: Research
Stage 2: Analysis and Initial Synthesis
Stage 3: Final Synthesis and Proposal

Learning Outcomes
At the end of the Seminar Course students are expected to:
1. Have acquired knowledge of the concepts and principles in the field of Biomimetics, and their potential for the design and production of materials, structures and forms.
2. Have acquired an understanding of how to abstract processes and parameters from a natural being situated in a specific environment.
3. Have developed the ability to design an ‘experiment’ using computation tools abstracted from a natural system to generate forms and structures, and to use analytical methods to evaluate the results.
4. Have acquired skills in working in biomimetic design;
5. Have acquired skills in the documentation and presentation of the aims and context of the design experiment, the process, products and the analysis of the results.

Assessment Criteria
1. The demonstration of an understanding of the theories, practices and technologies of Biomimetic Design.
2. The demonstration of a clear formulation of a hypothesis, and an ability to plan and pursue a critical agenda for research into the performance of structure, material and organisational systems in biological and architectural systems.
3. The development of skills and analytical reasoning in the formulation of potential component systems and performance criteria for architecture derived from Biomimetic research.
4. The demonstration of clear structure, precise writing and presentation of the research, analysis and abstracted principles of natural systems.
5. The demonstration of judgement in the deployment of research material and knowledge gained from analysis of natural systems.

Preparatory Reading


Greenberg, E., Jeronimidis, G., ‘Variation and Distribution: Forest Patterns as a Model for Urban
Evolutionary Algorithms have been used extensively in recent years to mimic the principles of evolutionary science to solve common real-world problems through search and optimization procedures of single or multiple objectives. Ranging from the fields of economics to politics and music to architecture, evolutionary algorithms have proven to be an efficient problem-solving technique to find multiple trade-off solutions for problems that possess multiple ‘fitness criteria’ (objectives) that are in conflict with one another.

The aim of the seminar is to introduce the concepts of multi objective optimisation as well as to develop an understanding of their application in design primarily through the development of urban tissues. The three sequences that comprise the seminar will provide the necessary knowledge for the utilisation of multi objective evolutionary algorithms across a range of scales as well as varying degrees of complexity. Although challenging, once mastered, their application becomes a robust tool in addressing design problems comprising multiple conflicting objectives that hold no clear single design solution.

**Document Submission (Team):** The document presents the aims of the design experiments, the logics of the processes, the Superblocks and associated System Territories that have been generated, and the analysis of properties and performance. Each Sequence of the generative experiment is to be presented in the document, together with the initiating and revised computational strategies made between each Sequence and the rationale for them. It will also include a full data set of the modelled Superblocks and Territories, their ranking in populations, their emergent spatial phenomena and networks, and a reflection on the potential variations needed for placement in differing climates.

**Document Submission (Individual):** An individual 2,500 word critical essay is to be submitted that explores aspects covered in the seminar course. The document situates the work in relation to the domain of evolutionary computation and critically reflects upon the achievements and limitations of the team experiments and analysis. It reflects upon the personal skills and knowledge gained and how they can be further developed in the future, together with a commentary on their participation and contribution to the team and the results.

**Course Sessions**
- Stage 1: The Experiment – Sequences 1, 2, and 3
- Stage 2: Sequence II - Morphological Variation of the Urban Superblock
- Stage 3: The Urban Superblock in Context

**Learning Outcomes**
At the end of the Seminar Course students are expected to:
1. Have acquired knowledge of the concepts and philosophies in the field of Emergence, and their potential for the design and production of materials, structures and forms.
2. Have acquired an understanding of the basis of Evolutionary Computation and Generative Design;
3. Have developed an ability to design an ‘experiment’ using evolutionary computation tools to generate forms and structures, and to use physical modelling to test and evaluate the results.
4. Have acquired skills in working in Evolutionary Computation and digital design;
5. Have acquired skills in the documentation and presentation of the aims and context of the design experiment, the process, products and the analysis of the results.

Assessment Criteria
1. The demonstration of an understanding of the concepts of Emergence and Evolutionary Computation, of the strategies for applying different algorithmic approaches to design, and the use of analytical tools for the evaluation of outputs;
2. The demonstration of clear formulation of aims for computational design experiments, and an ability to plan and pursue a research agenda in Evolutionary Computation;
3. The development of design skills and analytical reasoning in the construction and evaluation of genetic algorithms;
4. The demonstration of clear structure, precise writing and clear presentation of experimental work;
5. The demonstration of judgement in the deployment of research material and knowledge gained from design experiments; and an ability to place this in the theoretical context of Emergence.

Preparatory Reading


Submission Date: 10 February 2020 (Monday, Week 6, Term 2)

Design Projects:
Design I: Digital & Material Fabrication
Design II: Ecological Urban Design

The research ambitions, investigations and experimentations of Emtech are founded on the understanding that Nature and Artifice are strongly coupled, and that the exploration, design and production of artefacts and urban tissues is a cultural activity to be pursued as the design of systems that exist as part of the environment of other active systems. We also share an understanding that causality of change is complex and multiscale, that the dynamics of change are perturbed and accelerated by human activities, and are deeply concerned for the consequences of those changes to society and the natural world. The Biomimetics and the Emergence Seminar Courses have introduced the abstraction and systematisation of knowledge of biological morphogenesis and evolution to contribute to innovative computational processes of architectural design at a variety of scales. The skills and knowledge acquired are tested, extended and developed in the Studio Design Projects. There are three stages - Design Strategy, Design Experiments and Design Proposal.

Design I: Digital & Material Fabrication
Design I – Digital & Material Fabrication explores physical and digital computational techniques used to develop the architectural qualities of different material systems adapted for specific climatic contexts. Digital models will explore possibilities in response to various environmental parameters while physical models will explore the integration of material behaviour and robotic fabrication
processes. Techniques derived from the concepts and knowledge of the hierarchical organisation of biological systems and computational models, developed in the seminar Course ‘Natural Systems and Biomimetics’, will be implemented. The opportunities and limitations of selected robotic fabrication techniques will be associated with the material organization, fabrication, and assembly workflows of a one-to-one scale working prototype. The purpose of Design I is to design, develop computational workflow techniques, analyse, and fully fabricate material systems that are situated within EmTech Design & Build research agenda.

Course Sessions
Stage 1: Robotic fabrication workshop
Stage 2: System Design
Stage 3: Material Prototyping

Learning Outcomes:
1. Understanding of materials/material processes, modelling and digital fabrication techniques.
2. Development of experimental method and strategies in physical and digital experiments.
3. Demonstration of the capacity to apply acquired knowledge and techniques in a creative and innovative way to a material system.
4. Assimilation and familiarity with advanced digital and mathematic design techniques.
5. Assimilation and familiarity with advanced digital structural and environmental analysis.
6. Assimilation and familiarity with robotic fabrication techniques.
7. A thorough knowledge of the specific concepts, techniques and practices in the field of Emergent Technologies and their effects on the production of built architectures and artefacts.
8. The ability to connect analysis to design philosophies and material strategies, and relate them to processes of production.

Assessment Criteria:
1. The demonstration of an understanding of the concepts, strategies and analytical tools of Design I.
2. The demonstration of knowledge and skills of geometrical and topological analysis, digital morphogenesis and computational design processes, material behaviour, robotic fabrication techniques and assembly processes, and the appropriate deployment of that knowledge and skills in an integrated process.
3. The demonstration of judgement in the deployment of knowledge and skills, and the ability to place these in an appropriate theoretical context.
4. The demonstration of a clear structure and organisation for the presentation of work, and the ability to plan, develop and present comprehensive and precise documentation.
5. The demonstration of skill and judgement in the unfolding of a critical argument with evidence gained from experiments, and the skill to place this in the theoretical context of Design Science.

Preparatory Reading


Submission Date: 06 January 2020 (Monday, Week 1, Term 2)
Design II: Ecological Urban Design

Design II: Ecological Urban Design is focused on creating new design experiments and system logics for ecologically sensitive settlements with urban tissues in extreme climates and ecological contexts. It is founded on the logic that the patterns of human inhabitation are determined by the needs of the infrastructure of the ecology - designed, grown and developed as integrated natural and cultural systems, with the ambition to be resilient to change. Designs will be developed for a land/water entity that is both a place of mariculture production and a place of inhabitation for people. Situated in the intertidal zone and marshes, the design will integrate wetlands and their intricate hydrological reservoirs and hydrological networks with patterns and clusters of dense and/or distributed urban blocks and associated productive landscapes that have their own intricate networks.

Each team will design a fragment of an innovative ecological urban tissue of the capacity for 50,000 people, situated in and fully integrated with a landscape that is organised and divided by a repertoire of ‘hard’ defences of dykes and dams, seawalls, polders, sluices, culverts and levees to keep the water out and/or make it go elsewhere, and by soft defences of wetlands, marshes and bayous et al. to absorb, hold water and slow its inevitable rise. The distribution and variation of superblocks and associated productive territories require their own spatial and programmatic patterns and effects and articulate the infrastructure of the landscape.

Course Sessions
Stage 1: Design Strategy
Stage 2: Design Experiments
Stage 3: Design Proposal

Learning Outcomes:
At the end of Design Project students are expected to:
1. Have further developed their knowledge of the evolutionary computation techniques and multi-parameter analysis, and have developed skills in their use.
2. Have acquired knowledge and skills in ecological analytical techniques and be able to develop appropriate strategies for inhabiting and regulating ecological systems;
3. Have acquired skills in synthesis of collated climatic and ecological data with design ambitions, be able to integrate those skills in the strategic choice and optimisation of strategies and design development.
4. Have developed knowledge and skills in advanced generative computation and be able to deploy those skills.
5. Have developed knowledge and skills in the analysis and evaluation of morphological systems for a range of complex urban ecological conditions; and be able to deploy those skills appropriately.

Assessment Criteria:
1. The demonstration of an understanding of the concepts, strategies and analytical tools of the Studio.
2. The demonstration of knowledge and skills of analysis, digital morphogenesis and evolutionary computational design processes, and the appropriate deployment of that knowledge and skills in an integrated process of design for a large urban ecological patch;
3. The demonstration of judgement in the deployment of knowledge and skills, and the ability to place these in an appropriate ecological, climatic and cultural context.
4. The demonstration of a clear structure and organisation for the presentation of work, and the ability to plan, develop and present comprehensive and precise documentation.
5. The demonstration of skill and judgement in the unfolding of a critical argument with evidence gained from experiments, and the skill to place this in the theoretical context of Emergence.

Preparatory Reading:
The Studio – Individual Final Submission

The Studio concludes with the submission of an individual Portfolio that brings together summaries of the work undertaken in the Design Projects and Seminar experiments, together with the Individual Dissertation Proposal, in one comprehensive portfolio structured by the Critical Reflection.

The Individual Dissertation Proposal is developed during the Thesis Formation Workshop, and submitted for approval. The Critical Reflection is the analysis of the individual student’s personal experience of the Studio, focused on the skills and knowledge acquired, the understanding of the significance of the data of the project and how the student intends to synthesize and integrate these in future activities and personal development. Included within the Critical Reflection is a review of the following questions:

1. Have you developed the ability to raise insightful questions and problems, formulating them clearly and precisely?
2. Have you learned to find, select and produce the data relevant to the questions, and to use appropriate techniques to interrogate the data effectively?
3. Have you developed well-reasoned arguments and conclusions, and have you contextualized them against relevant criteria and standards used in the field you are working in?
4. Have you become more open to other systems of thought, recognizing and assessing, as need be, the implicit assumptions and practical consequences of that mode of thought, and are you able to apply the same criteria to your own work?
5. Are you a good team member, have you communicated effectively with others and have you made a significant contribution to the group solutions to complex problems?

Submission Date: 20 April 2020 (Monday, Week 1, Term 3)

PHASE 2: The Dissertation

Dr. Elif Erdine and Dr. Michael Weinstock, with Alican Sungur, Eleana Polychronaki, Abhinav Chaudhary, and Lorenzo Santelli.

The Dissertation is a written and illustrated account of an original inquiry in design research, pursued through a close and careful study that is structured to yield new designs, or to integrate existing designs into a new synthesis. The activity of designing constitutes a crucial mode of research specific to the architectural discipline. The enquiry takes place within the context of the design studio. Architectural designs that contribute to knowledge are those that lead to new perceptions, to new material forms and processes, to the development of new architectural and urban systems, to new constructs that advance the existing understanding and quality of the built environment. Within the field of Emergent Technologies and Design it is expected that quantifiable scientific knowledge will provide the appropriate model of study that may be coupled to appropriate culture models.

Architectural designs that contribute to knowledge are those that lead to new perceptions, to new material forms and processes, to the development of new architectural and urban systems, to new constructs that advance the existing understanding and quality of the built environment. Within the field of Emergent Technologies and Design it is expected that quantifiable scientific knowledge will provide the appropriate model of study that may be coupled to appropriate culture models.

The Dissertation Research Studio is focused on extending the acquisition of research competencies and their application to advanced production in architecture, urbanism and ecological engineering.
Radiation analysis

Location: Chicago
Time: 6:00 - 18:00
Day: 1 January - 30th January

Radiation value (A) | 1.5503 x 10^6 Kwh/m²
Building surface area (B) | 205,516 m²
Ratio A/B | 7.73

1.0729 x 10^6 Kwh/m²
178,035 m²
6.02

1.7704 x 10^6 Kwh/m²
259,327 m²
6.81

1.1096 x 10^6 Kwh/m²
173,181 m²
6.40
New Habitat Module Construction

Phase 1

Phase 2

Phase 3

Emergent Technologies and Design
Students further develop their abilities to analyse complex issues and to engage in independent research, integrating insights gained from case studies with insights gained from Digital and material experiments. Students integrate explorations of the theoretical discourses, relevant sciences and case studies of ‘state of the art’ projects in the domain of their chosen topic, and set out the methods and protocols for the development of their Design Proposal. The development and conclusion of the final proposal is pursued through the iterative design cycles that students have acquired knowledge and skills in during the early phases of the programme.

The form in which the Dissertation is to be presented includes text, illustration and original unique three-dimensional designs. Design research will necessarily be supplemented and substantiated by various scientific methods of analysis and evaluation. The design will be expressed and evaluated with respect to these scientific methods, and accompanied by textual exegesis that situates, frames and communicates the contribution to the field of architectural design.

Design research is usually situated in one of the two main fields of investigation, but it may be a hybrid that combines some aspects from the other. Students work in pairs for the Dissertation, and individually on further development of their personal Critical Reflection that completed the Studio portfolio.

1. Dynamic Material Systems with Advanced Fabrication: focused on a medium scale building. This has been the principal topic of design research in the past.

2. Ecological Urban Design in emergent biomes: focused on algorithmic design for energetic models of new cities and settlements and their integrated technologies at the scale of an ecologically defined landscape such as a shoreline, river valley, delta or hillside.

The Dissertation is to be organized in the following way:

**Abstract:** The original proposal, which will be revisited several times as the work progresses.

**Introduction:** Written last.

**Map of Individual Contributions to the Dissertation and short commentary.**

**Chapter 1** - The Domain: the topic or area to be investigated, including precedents and the physics of the topic. This concludes with the precise design problem or question that is to be tested and developed. This must be a sharply defined question - not a general discussion, for example, on metabolism or network topology. Precision requires definitive statements of the parameters that control or limit the work, its contribution to the field and the means by which it will be measured.

**Chapter 2** - Methods: the methods and techniques that are the current state of the art in the profession and research, the digital and physical techniques you intend to use in your investigation, their relation to the ‘state of the art’, and how you have tested their effectiveness and calibrated them.

**Chapter 3** - Research Development: the first experiments, digital and physical, and their evaluation, and how they give an insight to the concluding statements of the Domain Chapter - and have contributed to the refinement of the research question.

**Chapter 4** - Design Development: more complex design experiments at higher systems level.

**Chapter 5** - The Design Proposal: the final proposal in all its detail.

**Chapter 6** - Evaluations and Revisions/Future Development.

**Critical Reflection (individual).**

**Submission Dates:**

**MSc. Final Presentation** 08 September 2020, Final Submission: 18 September 2020

**M.Arch. Final Presentation** 13 January 2021, Final Submission: 15 January 2021
8. TEACHING AND LEARNING STRATEGIES

A distinguishing characteristic of the programme is the emphasis on the team, and the skills and knowledge developed in collaborative learning, research and design. Students work in small teams in studios, workshops and seminar courses, and for their Dissertation choose their own team and topic. This is a reflection of the way in which architects work in the professional world, and in academic research in the Design Sciences. Individual intellectual and critical development is reflected in the personal essays that each student undertakes and submits during Phase 1 The Studio, and in the individual Critical Reflection that each student develops and submits with their Dissertation.

Design processes in this domain are distributed and collaborative, and are explored, developed and refined through iterative computational processes of serial experimentation and analysis, generative simulations and material fabrication. The programme is structured to provide skills and knowledge of a coherent set of linked and convergent discourses, methodologies and concerns that cross many different disciplines in Phase 1 (The Studio), and those skills are further developed and knowledge deepened in Phase 2 (The Dissertation).

Teaching strategies reflect this modality of research and design. Each member of the teaching team has their own speciality and active personal research, but also contributes to coordination of the agendas and delivery of each module and workshop, and to the programme as a whole. One or two members of the teaching team lead modules and workshops, but all teaching staff collectively attend key interim and other internal presentations to offer critical commentary and advice to clarify and develop the student work.

Student life in the programme provides additional opportunities for learning as all tutorials and instructions take place in open studio, and students attend and participate in all presentations by their colleagues in the programme. The programme facilitates the self-organisation of study groups and workshops for additional software skills in the evenings and weekends. For these reasons attendance in studio is mandatory Monday to Friday, and is monitored.

8.1 Course Participation
Participation in seminars, workshops and modules, and in studio generally is constantly monitored in studio discussions, design tutorials, and at presentations. If teaching staff have observed a lack of adequate participation, the student will receive a formal written warning from the Programme Director, and is required to attend a mandatory meeting with teaching staff tutors to review participation and learning progress. Failure to improve participation to suitable levels results in the student being asked to repeat Phase 1 studies in the programme in the following year, or in extreme cases, leave the programme permanently. Students of this programme and others in the AA School receive an intense, highly supervised and closely monitored learning experience. It is the responsibility of all students to ensure that the arrangements of their personal circumstances (including payment of tuition fees) enable them to participate in all aspects of their course/programme of study. Details of the processes and requirements outlined above are set out in 2.2.8 Attendance and Attendance Management Procedures of the Academic Regulations. Appeal procedures regarding these decisions are also summarised in the AA School Academic Regulations, which can be found under:

8.2 The Studio
The Studio workshops, seminars and design projects are led by EmTech staff and our associated researchers, and offer a creative and intellectually rigorous sequence that builds knowledge and skill. It provides an intensive engagement in Design Science and introduces our students to the wider community of design researchers in London practices. It concludes with guiding students through the formation of a detailed proposal for an original architectural inquiry that is to be pursued in the Dissertation.

The teaching team and invited guests give tuition in studio, and students develop their skills and knowledge through research and design experiments. The Studio introduces a range of concepts and methodologies, and students document their work and make regular presentations. These are brought together and presented at the end of each course in a final presentation for critical advice, and in the compiled final documents submitted for assessment. The documents describe the work undertaken by the student team, the rationale for the decisions made, analyses and critically reflects upon the output, and situates the work in its theoretical, research and professional domains. Tutorials aid students in focusing and developing their submissions.

The Seminar courses embedded in The Studio have a common structure and method, with appropriate variation in delivery. Students are asked to read preparatory or follow up material, and make short group or individual presentations of work set at the end of each session. Each course has a written submission by the student team that documents the work undertaken, and an individual essay that critically reflects upon the work undertaken by their team, and situates in its theoretical, research and professional domains. Tutorials aid students in focusing and developing their submissions.

Thesis Formation takes place in studio in an intensive and highly structured week at the end of Term 2. Morning sessions are focused on topic discussions, exchanges and negotiations, and the afternoon sessions in writing proposals that are in turn presented and discussed the following morning. Dissertation Proposals are submitted at the end of the week, with sharply defined Abstracts, Ambitions, Methods and Domain statements. The proposals are reviewed by the teaching team, discussed with the students, reworked if necessary, and formally accepted.

At the conclusion of Phase 1 - The Studio, all assessments of work submitted for the modules of the Studio are reviewed together with the Dissertation Proposal and Critical Reflection within the individual portfolio and students are then notified of progression to Phase 2 - The Dissertation.

8.3 The Dissertation
The third and fourth term are entirely dedicated to the production of the Dissertation, with continuous review and supervision in Studio by the teaching team. Tutorials are scheduled each week in advance. Students review and synthesize the analyses, research, and case studies of the practices of design and production particular to the research topic. In the Research and Design Studio - Term 3 - students develop two chapters of their Dissertation from the Dissertation proposal - The Domain and the Methods, and pursue design experimentation appropriate to the central arguments and technical propositions. Supporting documentation of analysis, research conclusions, and strategic design decisions and argumentation in support of the Dissertation is written and refined. In addition to the scheduled weekly tutorials, regular presentations are made and critical advice offered by the entire teaching team and invited guests.

Term 4 is focused on the design development and testing, and the final design proposal is produced, analysed, critiqued and refined. Tutorial arrangements, regular presentations and critical advice are similar to those in Term 3. The final presentations are to a panel of invited guests from practice and academia, and their critical advice is focused on the necessary steps to complete the Dissertation, and the finished document of the Dissertation is compiled and submitted.
9. ASSESSMENT PROCEDURES

Students are assessed on submitted essays, design projects, participation in workshops, group projects and presentations, and on the final Dissertation. All assessments are double marked, with written commentary and grades, and each student receives feedback and discussion on their assessment in individual tutorials. Essays and research documents associated with the design work are submitted (by the designated date) to the Graduate School Coordinator. The Design Research will also involve presentations within the third term. Students will make a final public presentation to invited critics near the end of the fourth term, and have the opportunity to incorporate revisions, additions and amendments in response to critiques.

All submissions are documented as a hard-copy and digital version. Digital submissions are to be uploaded on the AA server, JUPITER / EMERGENT-TECH-&-DESIGN / STUDENT.

Submission Dates:
Induction - The Boot Camp: 21 October 2019 (Monday, Week 5, Term 1)
Design & Technology: 18 November 2019 (Monday, Week 9, Term 1)
Natural Systems and Biomimetics Seminar Course: 02 December 2019, (Monday, Week 11, Term 1)
Design I - Digital & Material Fabrication: 06 January 2020 (Monday, Week 1, Term 2)
Emergence and Evolutionary Computation Seminar Course: 10 February 2020 (Monday, Week 6, Term 2)
Design II - Ecological Urban Design: 16 March 2020 (Monday, Week 11, Term 2)
The Studio - Individual Final Submission: 20 April 2020 (Monday, Week 1, Term 3)
MSc. Final Presentation 08 September 2020, Final Submission: 18 September 2020
M.Arch. Final Presentation 08 September 2020, Final Submission: 15 January 2021

The final MArch Dissertation or MSc Dissertation will be submitted by the end of the fourth term. All submissions are assessed and marked by two members of the programme's teaching staff. The External Examiners will have access to all Dissertations and a representative sample of Core Studio projects, seminar course essays and documents prior to the formal meeting of the Examination Board. The Examination Board will be composed of the Programme Director, staff and the External Examiners, assisted by the Graduate School's Administrative Coordinator.

The Examination Board has the responsibility for the final marking of all submitted work, and makes decisions on distinctions and resubmission. The Board and its External Examiner report to the AA Graduate Management Committee, which in turn reports to The Open University, the validating body for the AA Graduate School’s Masters Programmes. Notification of results is given to students by the Registrar’s Office through the Graduate School Coordinator.

To qualify for the MSc degree the students must achieve 50% or higher mark on overall average of Phase 1 - The Studio and Phase 2 - The Dissertation. The overall final mark is calculated as the average of course work and Dissertation.

Students who fail to attain a pass mark on one item of work (project or essay) within Phase 1 – The Studio may resubmit once only, and must achieve a pass before being allowed to proceed with Phase 2 – Dissertation. All resubmissions will be subjected to grade capping at 50%. Students who fail to achieve a pass mark in Phase 2 may resubmit once for the Examination Board of the following academic year.

The MArch and the MSc Certificate will be awarded “with Distinction” when the overall final mark is 80% or higher. All grades achieved by students will be kept on record in the AA Graduate School’s database, and are available for transcripts, but will not appear on the certificates.
9.1 Assessment Criteria and Grading
Criteria for Final assessments of the M.Sc. and the M.Arch. degrees:

1. The demonstration of clear and appropriate formulations of hypotheses and arguments, and the ability to deploy these in the planning and pursuit of an original and creative research agenda in the field of Emergent Technologies.
2. The demonstration of the ability to conduct critical and technical analysis and produce meaningful results.
3. The demonstration of judgment in the application of research knowledge in a creative and innovative manner to comprehensive digital and physical design experiments and design development.
4. The demonstration of the development of critical faculties and advanced skills in the development and evaluation of detailed and complex design proposals.
5. The demonstration of the capacity to deal with complex research and design issues systematically and creatively, individually and as part of a group.
6. The demonstration of the capacity for precise and clearly structured writing and diagramming with referencing using established and appropriate conventions, and the ability to communicate clearly.

9.2 The MSc. Dissertation
M.Sc.- the successful completion of the Studio (Phase 1) and successful completion of the M.Sc. Dissertation (Phase 2).

The M.Sc. Dissertation is required to demonstrate the capacity to apply the acquired knowledge and techniques in a creative and innovative way to a material prototype, to the system in which it is embedded, to its fabrications and assembly, and that is developed and evaluated within the context of a climatic or ecological set of parameters.

9.3 The MArch. Dissertation
M.Arch. - The successful completion of the Studio (Phase 1) and successful completion of the M.Arch. Dissertation (Phase 2).

The M.Arch. Dissertation is required to demonstrate the capacity to apply the acquired knowledge and techniques in a creative and innovative way to a set of architectural or urban forms that are developed within an ecological system, to a resolution sufficient to evaluate and refine the system level processes and performances central to the research questions.

70 and above A Excellent Pass / Distinction
65-69 B+ High Pass
60-64 B Good Pass
57-59 C+ Satisfactory Pass
54-56 C Adequate Pass
50-53 D Low Pass
49 and below F Fail

To qualify for the MArch degree the students must achieve 50% or higher mark on both the course work average in Phase 1, and on the Dissertation in Phase 2. The overall final mark is calculated as the average of course work and Dissertation.
TIMELINE OF PLASTIC POLLUTION AND SOLUTIONS

An average Greenhouse can be around 8,000 m²

11,125 m² Polyethylene Plastic
Changed on average of every 3 years.

ETFE
REPLACE

0 years
3 years
6 years
9 years
12 years
15 years
18 years
21 years
24 years
27 years

PE
RE-USE

2.11 tons of plastic
4.22 tons of PE

ETFE Greenhouse Life span
New Structural Design

Material Durability
It can be easily patched by heat sealing in case of ruptures.

Material Light Transmittance
The average life span of ETFE film is around 20 years or more.

8,000 m²
9,990 m² of ETFE

ETFE Greenhouse Life span
New Structural Design
<table>
<thead>
<tr>
<th>Year</th>
<th>Plastic Waste (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>8.44</td>
</tr>
<tr>
<td>33</td>
<td>10.66</td>
</tr>
<tr>
<td>36</td>
<td>12.77</td>
</tr>
<tr>
<td>39</td>
<td>14.88</td>
</tr>
<tr>
<td>42</td>
<td>16.99</td>
</tr>
<tr>
<td>45</td>
<td>18.10</td>
</tr>
<tr>
<td>46</td>
<td>20.21</td>
</tr>
<tr>
<td>47</td>
<td>22.32</td>
</tr>
<tr>
<td>48</td>
<td>24.43</td>
</tr>
<tr>
<td>49</td>
<td>26.54</td>
</tr>
</tbody>
</table>

Now there are around 36,000 hectares of Greenhouses in Almeria. In the recent years a percentage of that plastic has been recycled to reduce waste.

In 45 years ONE average Greenhouse will produce 28.65 tons of plastic waste. Plastic Greenhouses appeared in the 1960s in Almeria.

In 45 years ONE Bi-Pneumatic Structure will produce 3.72 tons of ETFE recyclable waste.
10. PROGRAMME RESOURCES

Please see the AA Student Handbook for resources available to all students.

10.1 Additional Information Resources
Specialised books and documents are available within the programme, from the Programme Directors or located in the studio hand library. A dedicated website makes available abstracts and technical research papers, software manuals and instructions, case studies of exemplary projects and links to external research institutions and information resources.

Outside the AA School the British Library, Imperial College of Engineering and the RIBA Library have collections of relevant publications. Students are assisted to join these libraries.

10.2 Workspace
Students in the Emergent Technologies and Design programme each have an individual workspace within the Studio.

10.3 Dissertation Archive
Completed EmTech dissertations from previous years are available for students to view in EmTech studio and are filed under four categories:
- Ecological urban design
- Dynamic material systems and robotics
- Advanced computational systems
- PhD theses

10.4 Learning Resources
Our tools in EmTech are computational. Throughout the course we will help you in the application of these tools, and have listed below a core group of those with which we encourage you to become familiar prior to your arrival in EmTech.

Software Downloads (all Windows-based): The following is an initial list of tools that we will work with together in the first few weeks of EmTech.

**Expertise within EmTech Studio staff** - which you can acquire during your time in the programme
- Computational design and fabrication – Rhinoceros 3D, Grasshopper
- Environmental analysis – Ladybug
- Structural analysis - Karamba
- Syntactical analysis – DeCodingSpaces
- Evolutionary computation - Wallacei
- Large scale fabrication and Robotics – Robots
- Simulation and Programming – Kangaroo, Python and C#
- Virtual Reality – Augmented Reality (VR – AR) – Unity

**Software Downloads (all Windows-based)**
It is expected that you have Rhinoceros 3D and Grasshopper3D installed in your laptops before the Programme begins.

- Rhinoceros3D (Version 6) (Grasshopper is included in Rhino 6. Kangaroo and GHPython are built-in features of Grasshopper.)
  https://www.rhino3d.com/6
• Grasshopper Add-Ons (You will need to create an account on Food4Rhino to download any plug-ins from this site)
  o Ladybug
  http://www.food4rhino.com/project/ladybug-honeybee
  o Karamba
  https://www.karamba3d.com/download/karamba3d-1-3-2-rhino6/
  o Syntactical Analysis – DeCodingSpaces
  https://toolbox.decodingspaces.net/
  o Wallacei
  https://www.wallacei.com/
  o Robots
  https://github.com/visose/Robots
  o Unity
  https://unity3d.com/
• Autodesk Flow Design
  https://www.autodesk.com/education/free-software/flow-design
• Autodesk CFD
  https://www.autodesk.co.uk/products/cfd/overview

**Learning Resources**

• Rhinoceros3D
  https://www.rhino3d.com/tutorials?PageSpeed=noscript
  http://www.rhino3dhelp.com/category/tutorials/
  http://digitaltoolbox.info/#
  https://www.rhino3d.com/download/rhino/6/essentialmathematics
• Grasshopper3D
  http://modelab.is/grasshopper-primer
  http://grasshopperprimer.com
  http://digitaltoolbox.info/#
  http://grasshopper3d.com
• Kangaroo
  https://www.grasshopper3d.com/group/kangaroo
• Ladybug
  http://www.grasshopper3d.com/group/ladybug/page/ladybug-teaching-resources
  https://docs.google.com/file/d/0Bz2PwDvkjovJclJDMHJVMHJWaFU/edit
• Karamba
  http://www.karamba3d.com/category/tutorials/
  http://www.karamba3d.com/category/examples/
• DeCodingSpaces
  https://toolbox.decodingspaces.net/
• Wallacei
  https://www.wallacei.com/
• Robots
  https://github.com/visose/Robots

• Python
  http://wiki.mcneel.com/developer/python
  http://www.designalyze.com/software/python
  https://pythonspot.com
  http://www.python-forum.org
  https://docs.python.org/3/

• C#
  http://designalyze.com/course/intro-c-scripting-grasshopper

• Unity
  https://unity3d.com/learn

• Autodesk Flow Design

• Autodesk CFD
  https://knowledge.autodesk.com/support/cfd/getting-started?sort=score
ARCTIC SYNTHESIS
Resource driven settlement strategies for life 60° N
RESPONSIVE GROWTH SYSTEM
[EmTech]

AA Emergent Technologies & Design
Graduate Programme

http://emtech.aaschool.ac.uk/