CIEE Prague, Czech Republic

Course title: Science, Engineering and Technology Workshops
Course code: ARCH 3003 CGAD
Programs offering course: Global Architecture and Design
Language of instruction: English
U.S. semester credits: 3
Contact hours: 45
Term: Fall 2020

Course Description

In architecture and urban design computation has always played a big role as both a tool and an inspiration. Computer technology in 1980s have given architects and engineers (Peter Eisenman, Frank Gehry, Frei Otto) parametric tools to analyze and simulate the complexity observed in nature and apply it to structural building shapes and urban organizational patterns. These automated processes were giving predictions of settlements, patterns, simulations and animated forms.

There is a clear distinction in the contemporary paradigm between computerized design and computational design (Kostas Terzidis, Achim Menges and Sean Ahlquist). While the first one (computerized design) suggests the use of the digital tools and the dramatic computational power of the machine, it still works with a conventional design processes, albeit accelerated by the use of modern technology. It is the second one (computational design), which truly opens the black box of the digital tool, and digitalizes not only the data but the whole process of the design thinking.

Generative, computational, digital, computer aided and associative design have been and will always be drawn from parametric tooling. The general idea is a parametric design method in which we formalize parameters based on our initial design ideas and then turning them into a responsive outputs (definitions, codes). These outputs are helping us to form an informationbased skeletons, which allows us to incorporate complex information in design objects and processes, as well as to response in real-time within the design workflow. Software tools are not only shaping a dialogue in the process of translating our ideas into architectural responses, but are also questioning our understanding for new materials and fabrication methods.

Global AD SET Workshop will function between digital and physical environment where we will primarily use Grasshopper - a visual node-based editor programming language developed by David Rutten at Robert McNeel& Associates. It runs as a plug-in within the Rhinoceros 3D CAD2 application. We will explore various morphologies, simulate aggregations and growth in natural tissues, study ecological and social behaviors that are bounded to the general Global AD Studio task. We will go through a physics-simulation engines such as Kangaroo, and introduce ourselves to the possibilities of scripting languages such as Python or C#. The course will prepare students to simulate complex material behaviors and, on that basis, generate material informed geometries.

Within this connection, students will also learn how to prepare design projects for fabrication and develop new set of skills for advanced fabrication and computational design.

Learning Objectives

By completing this course, students will:

• be able to understand the difference between computational design and computerized design.
• get familiarized with new materials and morphologies.
• get familiarized with high performance, cost feasible, and equitable technologies.
• develop computational design thinking and learn to use different parametrical digital tools.
• learn to work in a group using new technologies applied in urban context.

Course Prerequisites
Basic 3D modeling skills

Methods of Instruction
In class slide lectures, tutorials and desk crits of project development, material and fabrication lab experience.

Assessment and Final Grade
1. Modelling 20%
2. Algorithmic Design 20%
3. Fabrication 20%
4. Theoretical Knowledge of the Tools 20%
5. Class Participation 20%
TOTAL 100%

Course Requirements

Modelling
Students will model complex geometries within an appropriate detail level, will work in different scales and dimensions (multiscalar modelling) as well as learn of different representation strategies.

The modelling part is evaluated throughout the course, final evaluation (5%) is based on the SET submission in week 16.

Algorithmic Design
At the beginning students will have the opportunity to approach Grasshopper and the basics of parametric design while achieving immediate results. In the next step students will learn how to deal with the complexity of emergent patterns and how to evaluate their potential performance. At the end students will be able to simulate aggregations and growth in natural tissues, simulate ecological and social behaviors, generate specific self-organization morphologies and incorporate more specific evaluation criteria as well as generate emergent structure playgrounds with potential fields of social interactions.

The algorithmic design part is evaluated throughout the course, final evaluation (5%) is based on the SET submission in week 16.

Fabrication
The emerged studio project structures will be digitally modelled via component system and physically fabricated (hand build, 3D printed, CNC or Laser cut). At the end 2D drawings for laser cutting prototyping of the project structures will be extracted.
The fabrication part is evaluated throughout the course, final evaluation (5%) is based on the submitted physical model in week 16.

**Theoretical Knowledge of the Tools**

Students would be informed of the development and conceptual process behind contemporary digital design tools.

The theoretical part is evaluated throughout the course, final evaluation is based on the final studio project presentation, where the student would be required to explain his design including his theoretical knowledge of the tools.

**Class Participation**

Students should be present during lecture hours and follow the tutorial tasks. When there are no tutorials students are expected to work on their projects in studio and participate in desk crits.

**CIEE Prague Class Participation Policy**

Assessment of students’ participation in class is an inherent component of the course grade. Participation is valued as **meaningful contribution in the digital and tangible classroom**, utilizing the resources and materials presented to students as part of the course. Students are required to actively, meaningfully and thoughtfully contribute to class discussions and all types of in-class activities throughout the duration of the class. Meaningful contribution requires students to be prepared, as directed, in advance of each class session. This includes valued or informed engagement in, for example, small group discussions, online discussion boards, peer-to-peer feedback (after presentations), interaction with guest speakers, and attentiveness on co-curricular and outside-of-classroom activities.

Students are responsible for following the course content and are expected to ask clarification questions if they cannot follow the instructor’s or other students’ line of thought or argumentation.

The use of electronic devices is only allowed for computer-based in-class tests, assignments and other tasks specifically assigned by the course instructor. Students are expected to take notes by hand unless the student is entitled to the use of computer due to his/her academic accommodations. In such cases the student is required to submit an official letter issued by his/her home institution specifying the extent of academic accommodations.

Class participation also includes students’ active participation in Canvas discussions and other additional tasks related to the course content as specified by the instructor.

Students will receive a partial participation grade every three weeks.

**CIEE Prague Attendance Policy**

Regular class attendance is required throughout the program, and **all absences are treated equally regardless of reason** for any affected CIEE course. Attendance policies also apply to any required co-curricular class excursions or events, as well as Internship.
Students who transfer from one CIEE class to another during the add/drop period will not be considered absent from the first session(s) of their new class, provided they were marked present for the first session(s) of their original class. Otherwise, the absence(s) from the original class carry over to the new class and count against the grade in that class.

**Missing classes** will lead to the following penalties:

**90-minute semester classes:**

<table>
<thead>
<tr>
<th>Number of 90-minute classes</th>
<th>Equivalent percentage of the total course hours missed</th>
<th>Minimum penalty</th>
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</thead>
<tbody>
<tr>
<td>one to two 90-minute classes</td>
<td>up to 10%</td>
<td>no penalty</td>
</tr>
<tr>
<td>three 90-minute classes</td>
<td>10.1–15%</td>
<td>reduction of the final grade by 3%</td>
</tr>
<tr>
<td>four 90-minute classes</td>
<td>15.1–17%</td>
<td>reduction of the final grade by 5%; written warning</td>
</tr>
<tr>
<td>five 90-minute classes</td>
<td>17.1–20%</td>
<td>reduction of the final grade by 7%; written warning</td>
</tr>
<tr>
<td>six and more 90-minute classes</td>
<td>more than 20%</td>
<td>automatic <strong>course failure</strong> and possible expulsion</td>
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**180-minute semester classes:**

<table>
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<th>Number of 180-minute classes</th>
<th>Equivalent percentage of the total course hours missed</th>
<th>Minimum penalty</th>
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<tbody>
<tr>
<td>one 180-minute class</td>
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<tr>
<td>two 180-minute classes</td>
<td>10.1–20%</td>
<td>reduction of the final grade by 5%; written warning</td>
</tr>
<tr>
<td>three and more 180-minute classes</td>
<td>more than 20%</td>
<td>automatic <strong>course failure</strong> and possible expulsion</td>
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Persistent absenteeism (students approaching 20% of the total course hours missed, or violating the attendance policy in more than one class) will result in a written warning, a notification to the student’s home school, and possibly a dismissal from the program.

**Missing more than 20% of the total class hours** will lead to a **course failure**, and potential **program dismissal**. This is a CIEE rule that applies to all CIEE courses and is in line with the Participant Contract that each CIEE student signs before arriving on-site.

Late arrival to class will be considered a partial (up to 15 minutes late) or full (15 or more minutes late) absence. **Three partial absences due to late arrivals will be regarded as one full class absence.**
Students must notify their professor and Program Coordinators (PC) beforehand if they are going to miss class for any reason and are responsible for any material covered in class in their absence.

If missing a class during which a test, exam, the student’s presentation or other graded class assignments are administered, make-up assignment will only be allowed in approved circumstances, such as serious medical issues. In this case, the student must submit a local doctor’s note within 24 hours of his/her absence to the PC, who will decide whether the student qualifies for a make-up assignment. Doctor’s notes may be submitted via e-mail or phone (a scan or a photograph are acceptable), however the student must ensure that the note is delivered to the PC.

Should a truly extraordinary situation arise, the student must contact the PC immediately concerning permission for a make-up assignment. Make-up assignments are not granted automatically! The PC decides the course of action for all absence cases that are not straightforward. Always contact the PC with any inquiry about potential absence(s) and the nature thereof.

Personal travel (including flight delays and cancelled flights), handling passport and other document replacements, interviews, volunteering and other similar situations are not considered justifiable reasons for missing class or getting permission for make-up assignments.

For class conflicts (irregularities in the class schedule, including field trips, make-up classes and other instances), always contact the Academic Assistant to decide the appropriate course of action.

Course attendance is recorded on individual Canvas Course Sites. Students are responsible for checking their attendance regularly to ensure the correctness of the records. In case of discrepancies, students are required to contact the Academic Assistant within one week of the discrepancy date to have it corrected. Later claims will not be considered.

CIEE staff does not directly manage absences at FAMU and ECES, but they have similar attendance policies and attendance is monitored there. Grade penalties may result from excessive absences.

**CIEE Academic Honesty Policy**

CIEE subscribes to standard U.S. norms requiring that students exhibit the highest standards regarding academic honesty. Cheating and plagiarism in any course assignment or exam will not be tolerated and may result in a student failing the course or being expelled from the program. Standards of honesty and norms governing originality of work differ significantly from country to country. We expect students to adhere to both the American norms and the local norms, and in the case of conflict between the two, the more stringent of the two will preside. Three important principles are considered when defining and demanding academic honesty. These are related to the fundamental tenet that one should not present the work of another person as one’s own.

The first principle is that final examinations, quizzes and other tests must be done without assistance from another person, without looking at or otherwise consulting the work of another person, and without access to notes, books, or other pertinent information (unless the professor has explicitly announced that a particular test is to be taken on an “open book” basis).

The second principle applies specifically to course work: the same written paper may not be submitted in two classes. Nor may a paper for which you have already received credit at your home institution be submitted to satisfy a paper requirement while studying overseas.
The third principle is that any use of the work of another person must be documented in any written papers, oral presentations, or other assignments carried out in connection with a course. This usually is done when quoting directly from another’s work or including information told to you by another person. The general rule is that if you have to look something up, or if you learned it recently either by reading or hearing something, you have to document it.

The penalty ranges from an F grade on the assignment, failure in the course to dismissal from the program. The Academic Director is consulted and involved in decision making in every case of a possible violation of academic honesty.

N.B. Course schedule is subject to change due to study tours, excursions, or local holidays. Final schedules will be included in the final syllabus provided to students on site.

Weekly Schedule

Week 1
Class 1.1 Introductory lecture: Computational Design Thinking

Introduction to Rhinoceros 5.0

• Reading: AAD – p.15-p.33

Week 2
Class 2.1 Introduction to Grasshopper

Class 2.2 Basic geometry: vector, points, curves, surfaces, meshes

• Panelling, fields & attractors
• Interactive environment in Grasshopper

Reading: AAD – p.33-p.61

Week 3
Class 3.1 Lists & data management, data flow, operators, functions & booleans

Reading: AAD – p.69-p.120

Week 4
Class 4.1 Simulation and form-finding: Kangaroo

Class 4.2 Simulation and form-finding: Kangaroo

Reading: AAD – p.361-p.395

Week 5
Class 5.1 Simulation and form-finding: Kangaroo

Reading: AAD – p.361-p.395
<table>
<thead>
<tr>
<th>Week</th>
<th>Class</th>
<th>Topic</th>
<th>Reading</th>
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<tbody>
<tr>
<td>Week 6</td>
<td>Class 6.1</td>
<td>Fabrication tools: lasercutting and 3d-printing</td>
<td>AAD – p.309-p.360</td>
</tr>
<tr>
<td>Week 7</td>
<td>Class 7.1</td>
<td>Fabrication tools: lasercutting and 3d-printing</td>
<td>AAD – p.309-p.360</td>
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<tr>
<td>Week 8</td>
<td>Class 8.1</td>
<td>Looping tools: Anemone</td>
<td>AAD – p.297-p.309</td>
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<td>Week 9</td>
<td>Class 9.1</td>
<td>Agent systems</td>
<td>AAD – p.217-p.255</td>
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<tr>
<td>Week 10</td>
<td>Class 10.1</td>
<td>Agent systems</td>
<td>AAD – p.217-p.255</td>
</tr>
<tr>
<td>Week 11</td>
<td>Class 11.1</td>
<td>Optimization tools: Ladybug&amp;HoneyBee</td>
<td>AAD – p.441-p.461</td>
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<tr>
<td>Week 12</td>
<td>Class 12.1</td>
<td>Optimization tools: Karamba</td>
<td>AAD – p.405-p.440</td>
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<tr>
<td>Week 13</td>
<td>Class 13.1</td>
<td>Introduction to rendering</td>
<td>AAD – p.255-p.296</td>
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<tr>
<td>Week 14</td>
<td>Class 14.1</td>
<td>Introduction to animation</td>
<td>AAD – p.255-p.296</td>
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<tr>
<td>Week 15</td>
<td>Class 15.1</td>
<td>SET submission</td>
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Final Evaluation of Modelling, Algorithmic design, Fabrication, and Theoretical knowledge of the tools

Course Materials

Readings
AAD_Algorithms-Aided Design, Parametric Strategies Using Grasshopper® by Arturo Tedeschi
Algorithmic Architecture by Kostas Terzidis

Online Resources
Grasshopper specific:
http://www.grasshopper3d.com/ - Grasshopper website
http://www.grasshopper3d.com/page/tutorials-1 - Grasshopper tutorials page

Essential mathematics for computational design:
food 4 Rhino (home of all Rhino + GH Plugins):
http://www.food4rhino.com/

Introductory level:
http://ledatomica.wordpress.com/2012/02/05/bend-workshop-manual/
http://www.plethora-project.com/2012/02/05/rhino-grasshopper/
https://vimeo.com/user4779230/videos
http://www.exlab.org/category/resources/
https://vimeo.com/exlab
http://wiki.bk.tudelft.nl/toi-pedia/Grasshopper
http://www.liftarchitects.com/
http://designreform.net/
http://modelab.nu/?cat=3
http://www.i-m-a-d-e.org/fabrication