Learning from avian nest constructions

International collaboration online

Learning outcomes

1. Have a general overview of structural principles of natural and animal constructions.
2. Have specific knowledge of model-based avian nest constructions.
3. Be able to evaluate the physical integrity and spatial relationships of materials of avian nest constructions with the help of 3D modeling.
4. Be able to identify whether the structural morphology applies to the applied load, material properties, structural organization, or a combination of none of these conditions.
5. Be able to translate and apply evidence-based protocols on architectural-scale structures with the help of visual-based programming as 3D.
6. Be able to prototye scale models of the architectural parametric structures developed during the course.

Scope

Objects in nature possess distinct forms shaped by material formation processes. In architecture, natural constructions refer to those created by animals instead of human-made ones. Animals construct independent organizations using external materials to protect their offspring, and their breeds. These constructions are for maximum efficiency with minimal material usage. They exhibit various structural geometries such as cones, net structures, membranes and web structures, shells, folding structures, vaults, and solid structures.

Animal constructors differ in complexity based on species development. This course studies avian nests in detail, analyzing their manufacturing techniques, load capacity, and the forces influencing their final form. The study of animal constructions in architecture helps us understand the structural-functionality. As genetically based structures, Avian nests showcase intelligent design strategies that can find applications in designing equivalent architectural structures.

Tasks

After each video from the learning-from-nature series, the students are requested to upload a RAW to the Moodle room. RAW is an acronym for Reading and Writing, which refers to writing a short review (300 words) of some of the lessons learned from each lecture.

Presentation Exchange: Three asynchronous exchange sessions where students are requested to upload their presentations in a chosen platform and leave comments to the rest of their peers are planned.

Presentations: students are requested to prepare short presentations (similar to the TEDx format) for each synchronous meeting. In the follow-up meetings, they are asked to present the state of the work every week. In the submissions, we encourage the students to show not only the final results of their designs but also the process drawings and errors. Learning by doing is a must!

Students are supposed to work independently during asynchronous activities.

Forman

This online course combines a synchronous and asynchronous strategy to be implemented via the Moodle learning platform with a corresponding setup. Also, a film, a collaborative whiteboard platform where students and tutors can work remotely, will complement the Moodle learning room.

Regarding the asynchronous part of the course, we planned a series of lecture videos on the topic “Learning from nature.” The videos present a general overview of biological processes and their possible translation into technical solutions (fibers). The content of these videos allows the understanding of form, function, and self-organization. This helps students identify the subject in the study cases to further protocolize and translate them into the visual programming environments.

Due to the time difference between Germany and Argentina, we included these asynchronous meetings where each participant has to give a power review of each presentation available on Moodle. The tutors act as moderators and provide a final review on the board.

The synchronous takes place via the Zoom online meeting platform. During eleven online meetings, students exchange their experiences with peers and tutors. Two mid-term and a final review are planned. Here, students are expected to exhibit the state of their work and get feedback to improve and further develop their projects.

Social form

The course will take place online on Zoom and be presented on a mixed synchronous and asynchronous modality. The asynchronous allows students to manage their time and produce the material for the follow-up and review sessions.

The students are divided into two-member teams: one from Germany and one from Argentina.

We encourage the students to organize brainstorming and set up virtual meetings.

The official teaching language is English since we understand this language as a lingua franca between Spanish and German-speaking students. Nevertheless, when some team members can speak German or Spanish and feel comfortable speaking it, they can work together in the most convenient language.

Results

The rest of the penduline tit bird

The penduline tit is a small bird with a height of around seven centimeters. Its nest design—similar to that of many other birds—is built on branches, twigs and bushes, where the nest attaches to a branch.

For the interpretation of the nest, the students defined the chaotic bunch; the land can fit in its spade as a minimal unit or module. They represented it with a star-constituted shape of interconnecting sticks. Then, they generated the chaotic density of the natural nest in the 3D model by using different arrangements, layers, and sizes of these modules.

Methods

Using 3D modeling and visual programming tools allows a learning-by-doing approach within the course. In this respect, the parametric-based modeling toolGrasshopper plays a crucial role in allowing multiple solutions for a certain number of variables. The digital representation tool will help students to understand how simple components affect the whole structure. In this part of the course, GH experience is mandatory or would be highly appreciated. If one participant per team had some previous knowledge.

A series of video tutorials can be found in the Moodle learning room. Although virtual courses could represent a challenge by working with physical models, this course is an excellent opportunity to apply and explore digital modeling tools and help the participants to exchange knowledge within the digital environment.

Finally, the 3D models are to be prototyped by implementing Additive Manufacturing (AM). This technique presents the advantage of manufacturing the projects remotely designed by the team, giving them the opportunity of holding a material approach to the case studies simultaneously in different parts of the world.