Re-Shaping Nature

When Scientific Data
Meets Art & Design

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Have you ever wondered if experimental data can be turned into art? The Centre for the Advanced Study of Collective Behaviour (CASCB) and the Max Planck Institute of Animal Behavior (MPI-AB) collaborated with the Merz Akademie on a sci-art project called "Re-Shaping Nature". Now we are displaying the outcome of the partnership in an art exhibition at the CASCB.

The focus was on data visualization. Together with nine students from the Merz Akadmie, members of the CASCB and the MPI-AB participated in a semester-long course led by Mario Doulis and Jörg Frohnmayer, which took place during the winter semester 2021/2022. The intention of the course was to bring young students from arts and design in contact with scientists working at the CASCB and the MPI-AB. CASCB member Hemal Naik was responsible for initiating the project: "For me, art and science represent two sides of the same coin. Artists and scientists have much to learn from each ot-her's perspectives and methods. We wanted to create a platform for both parties to interact with each other and work together. This initiative helped both resear-chers and art students to explore a new perspective and add a new flavour to their own work."

Gaining insights into each other's work

The kick-off event was a two-day visit to the MPI-AB in Möggingen and the University of Konstanz, with the focus on gaining insights into each other's work and establishing connections between Merz students and CASCB and MPI-AB researchers. "This truly is an inspiring approach to have an interdisciplinary exchange" says Jörg Frohnmayer, research associate at the Merz Akademie. He appreciated getting a more detailed insight into a broad variety of research topics because "it encouraged art and design students to dig into "real research data" and it gave researchers an insight into artistic approaches for visualization." His colleague Mario Doulis, professor and head of the New Media Department at the Merz Akademie adds: "I know from my own experience as a design student doing an internship at Fraunhofer IAO how important it is to meet the people you work with in their working environment. During our visit, we could not only talk with the researchers directly about their work, we also got an impression of how a researcher's workday looks like. On the one hand, they work on completely different topics compared to designers or artists, on the other hand they are – what a surprise – people like you and I…"

Artistic twist

The students used datasets from behaviour experiments and gave the data an artistic twist.
They visualized, for example, a stork's journey, the mating behaviour of fiddler crabs or the echolocation of bats. MPI-AB postdoctoral researcher Daniela Perez thinks that "widely sharing scientific discoveries and data is a central, if not the most important, part of science." She shared her fiddler crab data because "the opportunity to get my science portrayed by artists is just too good to miss."

She is excited to see what these young inspiring artists will create with her fiddler crab data. She says: "I spent almost ten years studying fiddler crabs, and now I am transitioning to worms. This partnership with the Merz Akademie is a beautiful tribute to all those years dedicated to fiddler crab research."

How the collaboration came about

The collaboration began with a coincidental meeting between Hemal Naik and Maren Schmol, director of the Merz Akademie, in India. Naik suggested the idea of collaborating with art institutes or artists in order to create sustainable outreach programmes for science communication.
The idea was presented to Frohnmayer and Doulis at the Merz Akademie as well as several members of the University of Konstanz and the MPI-AB (including Falk Schreiber and Martin Wikelski) during a brainstorming meeting in the summer of 2019. Having gained initial support, Naik and Frohnmayer decided to work together and organized three courses between 2019 and 2020 to test the feasibility of such collaborations. The results are the projects 3D Data Storytelling, Fly like a Stork and Fly like a Starling.

"Several members of the MPI-AB and the CASCB showed interest and shared their data and insights," says Naik. "Finally, in 2021 we decided to go beyond concept and prototype development. That is why we organized the course with the concrete plan of setting up exhibitions of the artwork at the CASCB."

The White Stork Journey
by Paul Mignot

My project shows a stylized journey of a migrating white stork in the form of an animated poster. My goal was to enhance the information given in the animal tracker while visualizing the journey which a stork undertakes each year. The migration is visible through constant changes in whereabouts since the environment around the stork changes in small steps. Through the changes around the stork I wanted to portray the feeling of traveling and creating new places in between the four main scenes.

Original research project:

Collective sensing over multiple scales during migration
by Andrea Flack

What are you studying?
Andrea Flack: Our research focuses on analyzing the lifetime tracking data to understand how migration routes are developed over the stork's lifetime. We are also exploring hotspots of social information along the migration route, as well as investigating how migration timing influences group composition during migration.

How has the art project changed the way you look at your research subject?
Andrea Flack: This art project helps me to see the world through the eyes of my research subject and allows me to understand their decision-making.

Further involved researchers: Ellen Aikens and Martin Wikelski

Swarm Behaviour and Environments

by Jan-Filip Kvrgic

Inspired by Daniel Calovi's work with simulated swarm behaviour this project works with a similar implementation of algorithmic behaviour. The scene contains around 300 individual agents, both birds and fish, moving and interacting with each other according to a set of rules with separation, alignment, cohesion and user targets. A user can interact with the swarm through a Leap Motion sensor in ways that would be impossible in the wild.

Original research project:

Swarming, schooling, milling: phase diagram of a data-driven fish school model
by Daniel S. Calovi

What are you studying?
Daniel S. Calovi: Real-time three-dimensional fish school simulation that the user can experience in 3D and also interact with. The way fish move was inspired by previous scientific work trying to understand the rules of interaction between fish.

What are the core results of your research project?
Daniel S. Calovi: How tweaking social interactions between agents could drastically change their behaviour; classifying that behaviour and also investigating the transitions between them and their stability.

How has the art project changed the way you look at your research subject?
Daniel S. Calovi: Originally, the simulations were in two dimensions, it was great to see how a similar swarm would behave in three dimensions and to be able to interact with the swarm in real-time.

Further involved researchers: Ugo Lopez, Sandrine Ngo, Clément Sire, Hugues Chaté and Guy Theraulaz
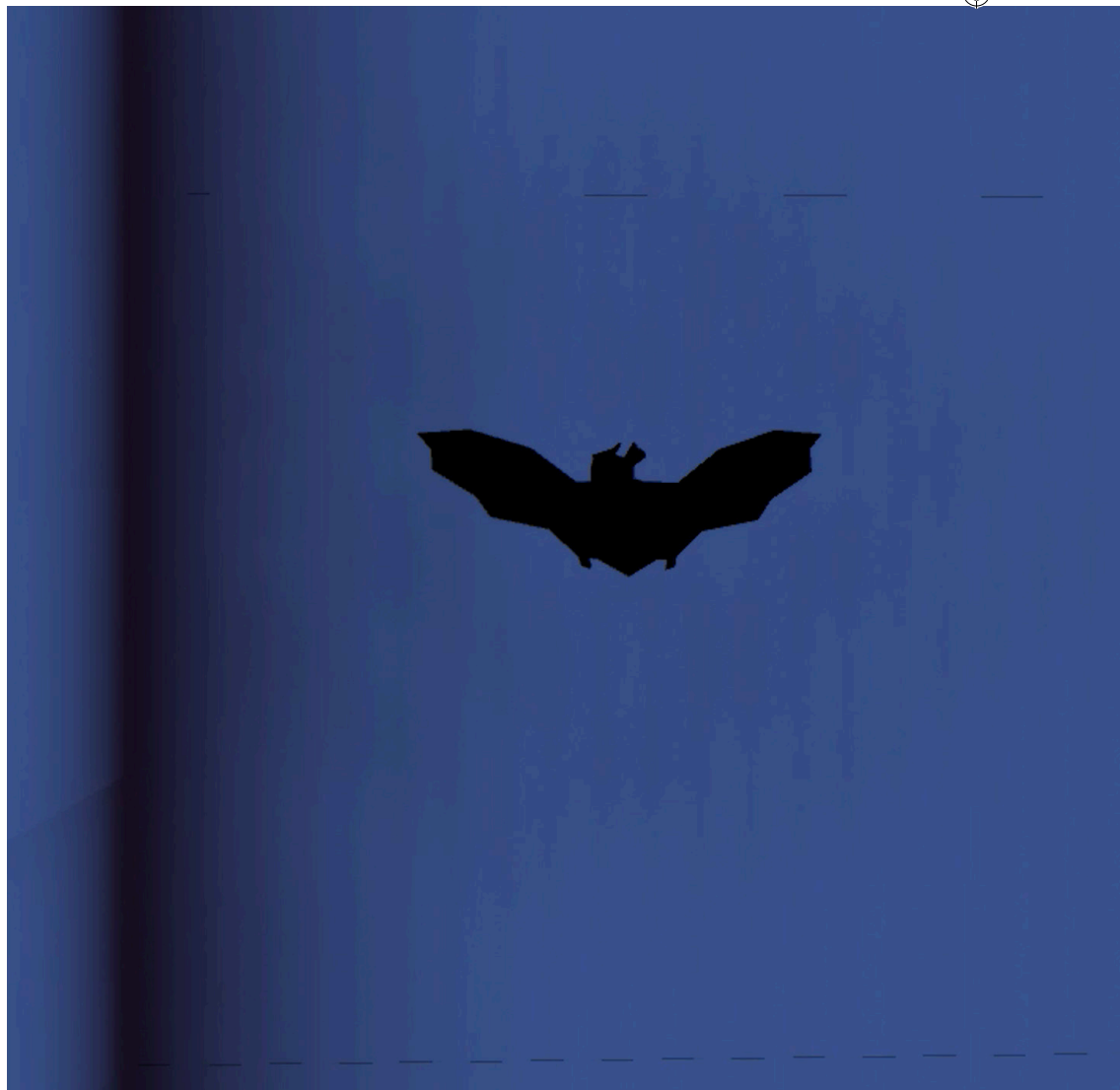
Bat VR Experience
by Melanie Müller and Nadine Frank

A 3D/VR-Installation to experience how the echolocation of a bat works. It aims to make echolocation more understandable for humans since people can't recognize a space from the sound.

1. Original research project:

Sensing and collision avoidance in a swarm of bats
by Aya Goldshtein

What were the core results of your research project?
Aya Goldshtein: In our study, we monitored the movement and acoustic scene in a swarm of bats. We found that bats experienced high conspecific masking when they emerged from their cave. But this interference drops rapidly seconds after their emergence due to the spreading of the bats in space.

How has the art project changed the way you look at your research subject?
Aya Goldshtein: This art project provides an opportunity to experience how bats perceive their environment using both sound and vision.

Further involved researcher: Yossi Yovel (Tel Aviv University)

2. Original research Project:

Active sensing and collective motion in groups
by Thejasvi Beleyur

What were the core results of your research project?
Thejasvi Beleyur: I am interested in how animals move and sense each other when they are in groups and have limited information about their surroundings. I studied groups of echolocating bats that jam each other due to their loud calls, but still manage to listen to faint echoes to detect each other.

How has the art project changed the way you look at your research subject?
Thejasvi Beleyur: The art project provided a great visual expression of what echolocation may feel like. The user-led experience is a neat idea! I'm glad my work could be of inspiration to someone else!

Further involved researchers: Bastian Goldluecke, Iain Couzin

Fiddler Crab Wave Visualization

by Isabel Carolin Kohlhagen

With this project I aimed to visualize a behaviour that is specific to fiddler crabs: waving. When sensing motion, the male crabs will wave their big claws to attract a potential mating partner.
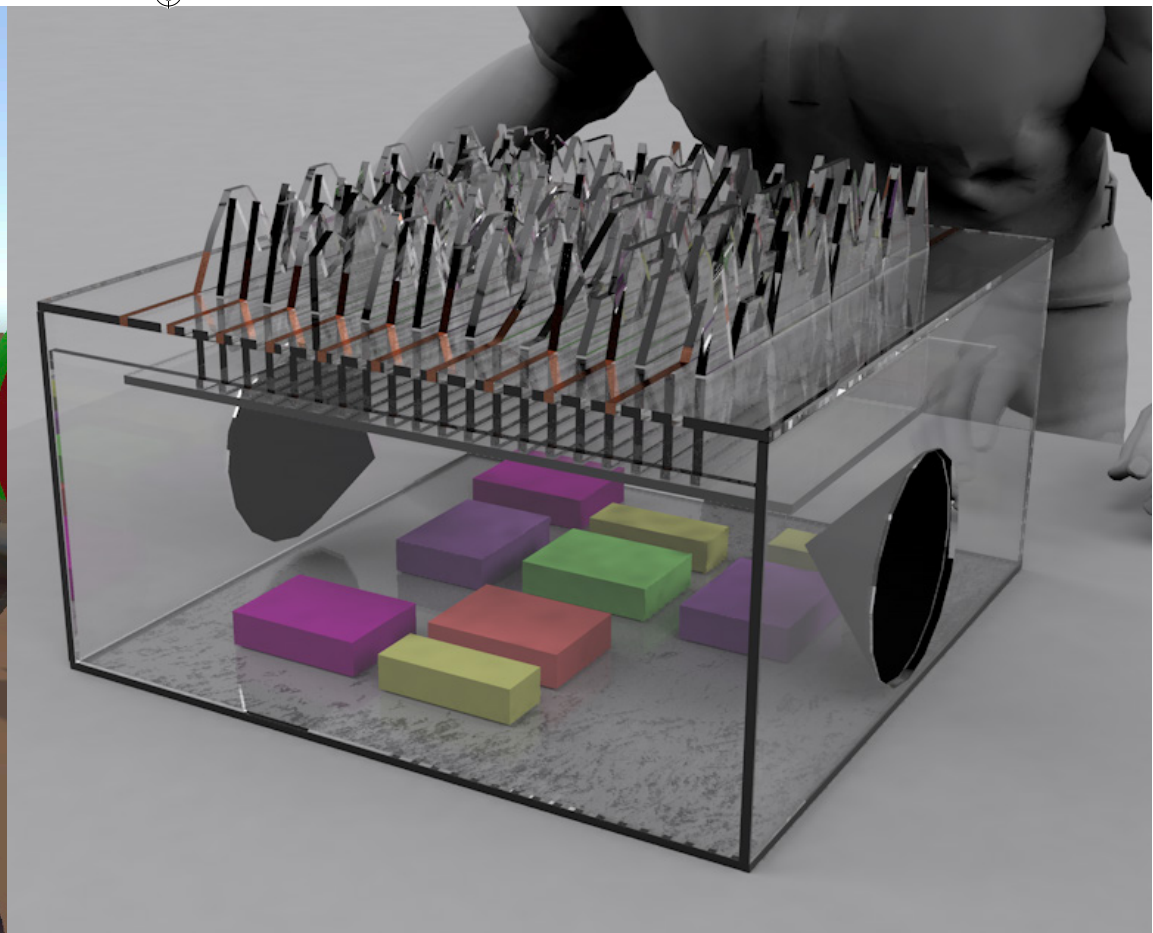To clarify whether this behaviour is based on motion or not, I created a 3D environment with animated crabs that is connected to a webcam. When the webcam senses motion, the 3D crabs starts to wave at you.

Waving Graphs
by Felina Russ

Waving Graphs is an interactive installation that can be experienced with different senses: auditory, tactile and visual. Data of the signature wave of male fiddler crabs to attract female fiddler crabs were used for this work. In addition, the entire structure represents the work of the scientists through its material and presentation. The technology that is made visible through plexiglass stands for working with sensors, cables and cameras.

A fiddler's world
by Vivienne Jahn

Welcome to the world of the sand fiddler crab! Here you can explore the habitat of the crab in life-size and learn about their species, behaviour and burrow construction.

The mating behavior is roughly divided into two main types: „burrow-mating" and „surface-mating". In „burrow mating" species, the male waves its enlarged claw to attract females to his territory and mate in his burrow.

Fiddler Crabs – Austruca mjoebergi Booklet

by Victoria-Luise Scheible

The booklet contains general information about Fiddler Crabs and introduces Daniela Perez, a researcher in this field. It is structured in the form of an interview, thus the texts are quick and easy to read.
The design is in black and white and the illustrations in ink and watercolor, therefore it looks very casual and stylish. The format is square, which transforms well onto the shape of the crabs. The last part of the booklet is dedicated to the topic, 'How to layout a booklet', in order to give a little insight into our design field.

Original Fiddler Crab research projects:

Ecology and signal structure drive the evolution of synchronous displays
by Daniela M. Perez

and

Imperfect synchrony in animal displays: why does it occur and what is the true role of leadership?
by Daniela M. Perez

What were the core results of your research projects?
Daniela M. Perez: We studied the diversity of courtship signals in fiddler crabs and the mechanisms that promote signal synchrony in some species. We unveiled ecological effects, such as habitat and mating systems, that have a strong influence on the evolution of courtship and synchrony in the group.

How has the art project changed the way you look at your research subject?
Daniela M. Perez: The projects exhibit fiddler crabs' behaviour and ecology in beautiful and creative ways. They reveal how the data can be differently interpreted and yet produce meaningful and accurate representations. It gives me great satisfaction to share common interests with artists, who helped me see my research with a more flexible and comprehensive perspective.

Further involved researchers:
Project 1: Enzo L. Crisigiovanni, Marcio R. Pie, Ana C. Rorato, Sergio R. Lopes, and Sabrina B.L. Araujo
Project 2: Cristian L. Klunk and Sabrina B. L. Araujo

The Merz Akademie
The Merz Akademie is a University of Applied Art, Design and Media in Stuttgart, founded in 1918. The fields of study are: Crossmedia Publishing, Film and Video, New Media and Visual Communication with special interest in theory and cultural studies.

The Centre for the Advanced Study of Collective Behaviour
At the Centre for the Advanced Study of Collective Behaviour (CASCB), we create a global hotspot for the integrated study of collective behaviour across a wide range of species and across scales of organisation. We are a Cluster of Excellence within the framework of the Excellence Strategy of the federal and state governments.

The Max Planck Institute of Animal Behavior
The Max Planck Institute of Animal Behavior aims to achieve a quantitative and predictive understanding of animal decision-making and movement in the natural world. Pursuing an integrative approach, they combine physiological, neural, ecological and evolutionary perspectives, questions and methods.

Involved People

Course leader:
Mario Doulis and Jörg Frohnmayer – Merz Akademie

Course concept:
Mario Doulis, Jörg Frohnmayer and Hemal Naik (MPI-AB and CASCB Affiliate)

Students from Merz Akademie:
Nadine Frank, Vivienne Jahn, Isabel Kohlhagen, Jan-Filip Kvrgic, Paul Mignot, Melanie Müller, Felina Russ, Victoria Scheible

Researchers from MPI-AB and CASCB who provided data for the art projects:
Thejasvi Beleyur: Bat project, Daniel Calovi: Fish project, Andrea Flack: Stork project, Aya Goldshtein: Bat project, Daniela Perez: Fiddler crab projects

Organization: Bhargav Solanki, Elisabeth Böker

Communication: Elisabeth Böker

Print Media Design: Paul Mignot

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