NaviSense
Cluster of Excellence

Carl von Ossietzky
Universität
Oldenburg

Fact-Sheet

NaviSense

International Cluster of Excellence for the Sensory Basis, Mechanisms, and Impacts of Animal Navigation

Applicant universities
University of Oldenburg (UOL)

Participating institutions
Institute of Avian Research (IAR), Wilhelmshaven, University of Bayreuth

Duration of funding and funding amount applied for
2026 – 2032 / 54,728,000 euros

Spokesperson
Prof. Dr. Henrik Mouritsen

Number of scientific project leaders
36, including 35 at the University of Oldenburg of which six are international researchers who will become members of the University of Oldenburg for the project

Number of participating researchers
Around 80 from the fields of biology, physics, chemistry, computer science and the social sciences, among others

Background

Research into animal navigation at the University of Oldenburg began more than 20 years ago with the "Neurosensorics / Animal Navigation" research group headed by Henrik Mouritsen | The University has since become a leading institution worldwide in the field of animal navigation and magnetoreception research thanks to strategic professorial recruitments and a strong interdisciplinary and collaborative spirit | Milestones: funding for the Research Training Group "Molecular basis of sensory biology" (DFG / 2013-2023); funding for the Collaborative Research Centre "Magnetoreception and Navigation in Vertebrates: from Biophysics to Brain and Behaviour" (DFG / since 2019); European Research Council Synergy Grant for the "Quantum Birds" project (Henrik Mouritsen and Peter Hore (University of Oxford) / since 2019).

What it's all about?

The **scientific** goal of NaviSense is to provide a deep, interdisciplinary understanding of the senses, mechanisms, and behaviours used by animals to navigate, and how these mechanisms can inspire technology and impact society, ecology, and biodiversity.

The **structural** goal is to root a long-term "International Centre for Animal Navigation" at the University of Oldenburg for decades to come and thereby strengthen UOL as an internationally leading institution for interdisciplinary research in this field.

The **collaborative** goal is to unite leading scientists across all experience levels from an exceptionally wide range of fields in a stimulating environment. This is essential to be able to answer the scientific questions posed in NaviSense.

Research foci (RF)

1. Animal navigation mechanisms and their underlying senses

The focus here is on basic research. The goal is to understand the senses and mechanisms that enable animals to orientate and navigate over middle to long distances – often with an accuracy that remains unattainable for human navigators without GPS. This encompasses highly interdisciplinary research in areas such as the underlying sensory mechanisms of magnetoreception and the visual sense, on the celestial, wind and magnetic compasses, path integration and how animals define "home", etc. Studies on various organisms are planned, including magnetotactic bacteria, bogong moths, ants, monarch butterflies, dung beetles, krill, migratory birds and bats.

Objective

To gain a better understanding of the sensory systems and mechanisms that enable animals to navigate over long distances. Among other things, the aim is to clarify which of the animals under investigation can perceive the magnetic field (as far as not yet known), which mechanisms play a role here (quantum effects and/or magnetic particles) and whether the magnetically sensitive protein cryptochrome (identified by the UOL) really is the long-sought magnetic sensor in migratory birds.

2. Quantum effects at ambient temperature in model systems and biology

In this research focus, a team of chemists and physicists will work to gain a better understanding of how the above-mentioned quantum effects can influence processes at ambient temperature. In order to understand the exact chemical, physical and quantum mechanical principles underlying magnetoreception, the proteins and model compounds produced in the first research focus will be analysed using state-of-the-art spectroscopic methods (developed in Oxford and Oldenburg).

The background to this is that the mechanisms on which the Cluster focuses are based on very similar physical laws to certain forms of recently developed quantum technologies. However, the latter generally function only at extremely low temperatures. Understanding how these quantum mechanisms can function in the wet, warm and "noisy" environment of a cell in a bird's eye therefore would have enormous potential for technological advances.

Objective

The team plans to use for example model systems to understand whether qubits (basic information unit used to encode data in quantum computing) can remain stable over a longer period of time at room temperature in systems inspired by the radical pair mechanism.

3. Ecological and conservation consequences of animal navigation

Migratory animal species are particularly affected by climate change, environmental pollution and loss of habitat. The populations of many migratory species are in sharp decline. Attempts to rewild endangered species in suitable locations often fail because the animals reject these places as "home" and simply navigate away.

Objectives

To find out how animals define "home"; investigate the influence of human-made stress factors on the ability of animals to navigate; develop better, science-based conservation strategies for migratory species.

4. Linking biological and technical systems through models, algorithms, and devices

Animal navigation is highly reliable and energy-efficient. However, the system that makes this possible works in a very different way to human navigation systems, which often rely on just a few sensors, GPS and powerful computers. Animal systems are usually based on a large number of relatively imprecise sensors and they combine information from different senses. This makes them very resilient against disturbances and malfunctions.

Objective

To develop hearing devices that go beyond improving hearing and act as comprehensive hearing health systems on the ear“

5. From hearing to understanding for participation in society

In this area, the researchers plan to investigate the importance of hearing in more realistic contexts than has previously been the case, for example by using mobile technology to conduct hearing research in locations beyond the lab, such as the workplace or public spaces. To gain access to people and everyday acoustic environments they will convert a van into a „Hearing4all-connects-lab“. The scientists will also investigate the impact of multilingualism on hearing comprehension and how hearing loss affects social interactions.

Objective

Based on findings from animal navigation, biological and physiochemical navigation hypotheses will be developed and tested with the aim of providing concepts for highly robust technical navigation systems that are less sensitive to disturbances than current technologies (such as autonomous flying). These systems and principles will be tested in virtual and real robotic systems, for example.

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