

Intelligent Maritime Technology



Top-notch research on autonomous underwater robots

From the Deep Sea to the Ship's Hull

Autonomous underwater vehicles, tactile robotic grippers, robot systems for magnetic surfaces:

In the future, intelligent systems will operate in hardly accessible places posing a risk to human health. Examples include damage detection on ships (hulls and holds), exploration of unknown waters, repair and monitoring of onshore or offshore facilities, such as wind farms and coal-fired power plants. In these areas intelligent robots can support or even replace people and help to open up new fields.

The DFKI Robotics Innovation Center conducts research on algorithms and hardware designs enabling these systems to work independently and reliably over long periods of time.



Underwater vehicle "Dagon" in operation in the Baltic Sea

Artificial Intelligence is our Expertise

In the Robotics Innovation Center at the Bremen-based site of the German Research Center for Artificial Intelligence (DFKI) we pool know-how for the development and programming of intelligent mobile robots.

We draw our innovative strength from interdisciplinary cooperation. Computer scientists and engineers work together with computer linguists, physicists, neurobiologists and psychologists to rapidly transform scientific knowledge into practical, operational solutions.

Underwater robotics is one of the focal points of our work. We have eight teams conducting research on autonomy, system design, interaction, intelligent kinematics, sustained learning, hardware architectures and simulation. Our network consists of excellent universities like the University of Bremen, recognized institutes and industrial partners with global operations. We have outstanding laboratories and workshops, such as the newly built, two-story, 1,300 m² Maritime Exploration Hall (p. 4) offering ideal conditions for our research.



Pipeline tracking in the deep sea by means of intelligent robots

From Research to Application

As an industry-oriented research center, we rapidly implement scientific findings in practical solutions.

Our technologies can be used for:

- inspection, maintenance and installation of onshore and offshore facilities, sluices and dams
- inspection of hulls and other watercraft (inside and outside)
- execution of assembly work under water requiring fine motor skills
- survey and sampling of uncharted waters
- sustainable and environmentally friendly deep sea mining
- autonomous ship pilot assistance systems for maneuvers near shore



View of the saltwater basin in the Maritime Exploration Hall at our Bremen site

Unique in Europe: The Maritime Exploration Hall

Our 1,300 m² Maritime Exploration Hall is unique in Europe and serves to test new technologies. The heart of the facility is a large basin filled with saltwater, measuring 23 m x 19 m x 8 m.

That is where we conduct research on underwater vehicles under realistic conditions and simulate concrete scenarios in the offshore industry. In addition to use for our own work, this one-of-a-kind laboratory for both industry and science is also available to our cooperation partners.

What makes this test facility so special?

The hall stands out by virtue of its dimensions and the saltwater basin. The research conditions are not subject to changes in weather, they are controllable and directly observable. The infrastructure is a technical orchestra comprising the large basin, separate test basins, mechanical accessories, a pressure chamber and a virtual reality lab. By means of this interactive test environment, we are able to steer underwater vehicles equipped with integrated cameras through the basin in order to observe robots at close range. In the pressure chamber we can generate water pressure corresponding to a depth of 6,000 m, thus enabling us to make individual robot components ideally suited for diving purposes.



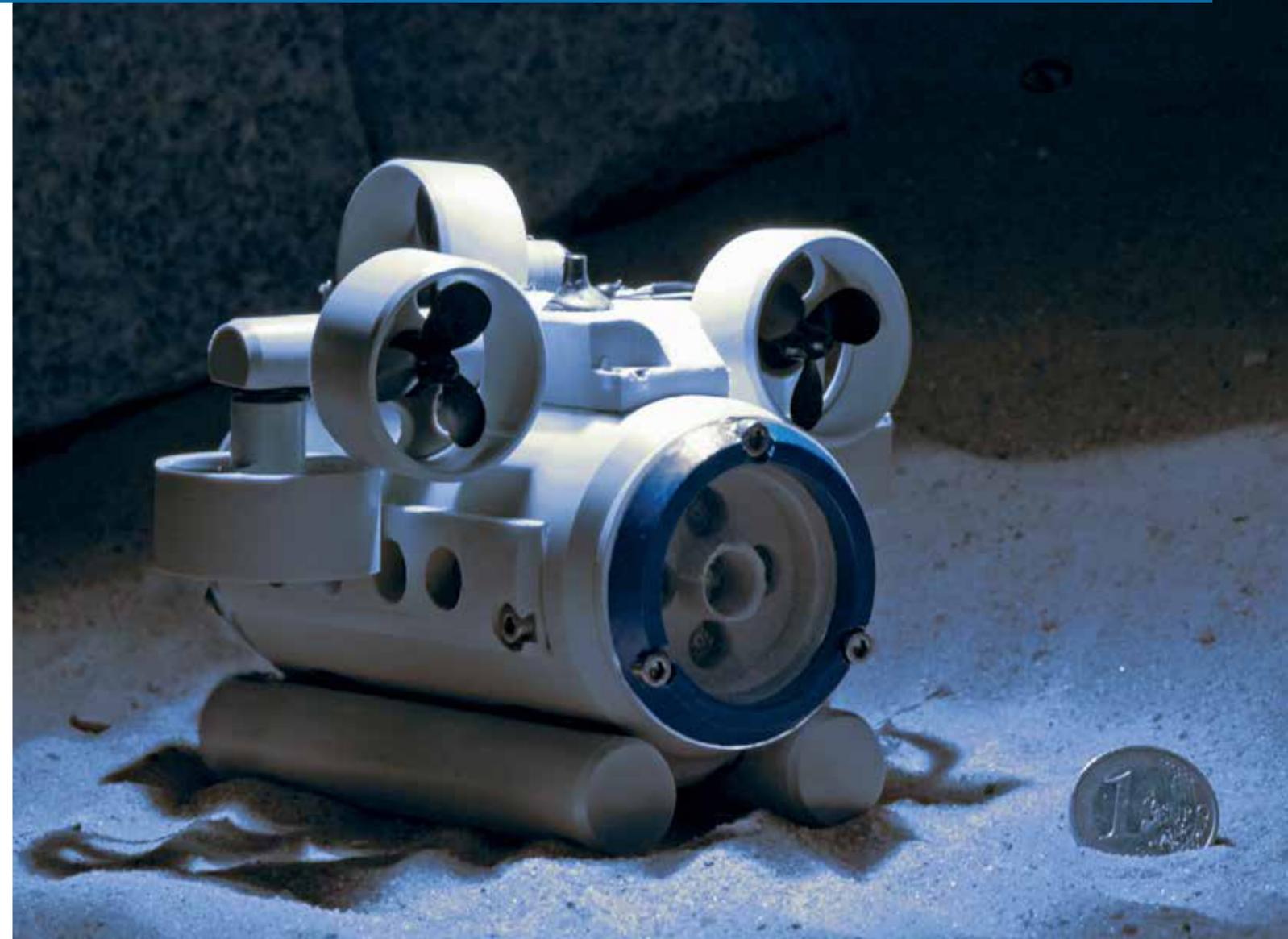
Diving in the glass tank: an AUV built by ATLAS Elektronik with integrated DFKI technology

The technical orchestra at a glance:

- a 23 m x 19 m x 8 m test basin, including mechanical infrastructure
 - 3.4 million liters of saltwater (18 g of salt per liter)
 - crane systems (12.5 t and 250 kg) to immerse systems and test objects in the basin
- separate test basins
 - a 5 m x 4 m x 2.2 m glass tank containing 40,000 liters with three glass walls for optimum observation of test runs
 - a 3.4 m x 2.6 m x 2.2 m black tank that can be covered to shield it against external light and permitting control of the water turbidity
- a pressure chamber
 - water pressure corresponding to a depth of 6,000 m (600 bar)
 - a gantry system for exact positioning of specimens
- a virtual reality lab as an immersive, interactive 3D test environment
 - projection surface consisting of seven elements with an overall area of 21.6 m²
 - interaction in a virtual test environment by means of a CyberTouch data glove
- workshops and workstations
- space for two 20' containers near the basin and a spacious logistics area in front of the building
- a window close to ground level that allows observers to look into the large basin

We Conduct Research on

- system development to support operation of remote controlled underwater vehicles using methods of virtual immersion
- autonomous manipulation and action planning of robotic grippers, in particular using camera-aided methods such as “visual servoing”
- image evaluation and object recognition by means of modular underwater cameras
- control methods for the next generation of autonomous underwater vehicles
- biologically inspired and energy-efficient forms of locomotion for autonomous underwater vehicles
- autonomous navigation and map generation by AUVs

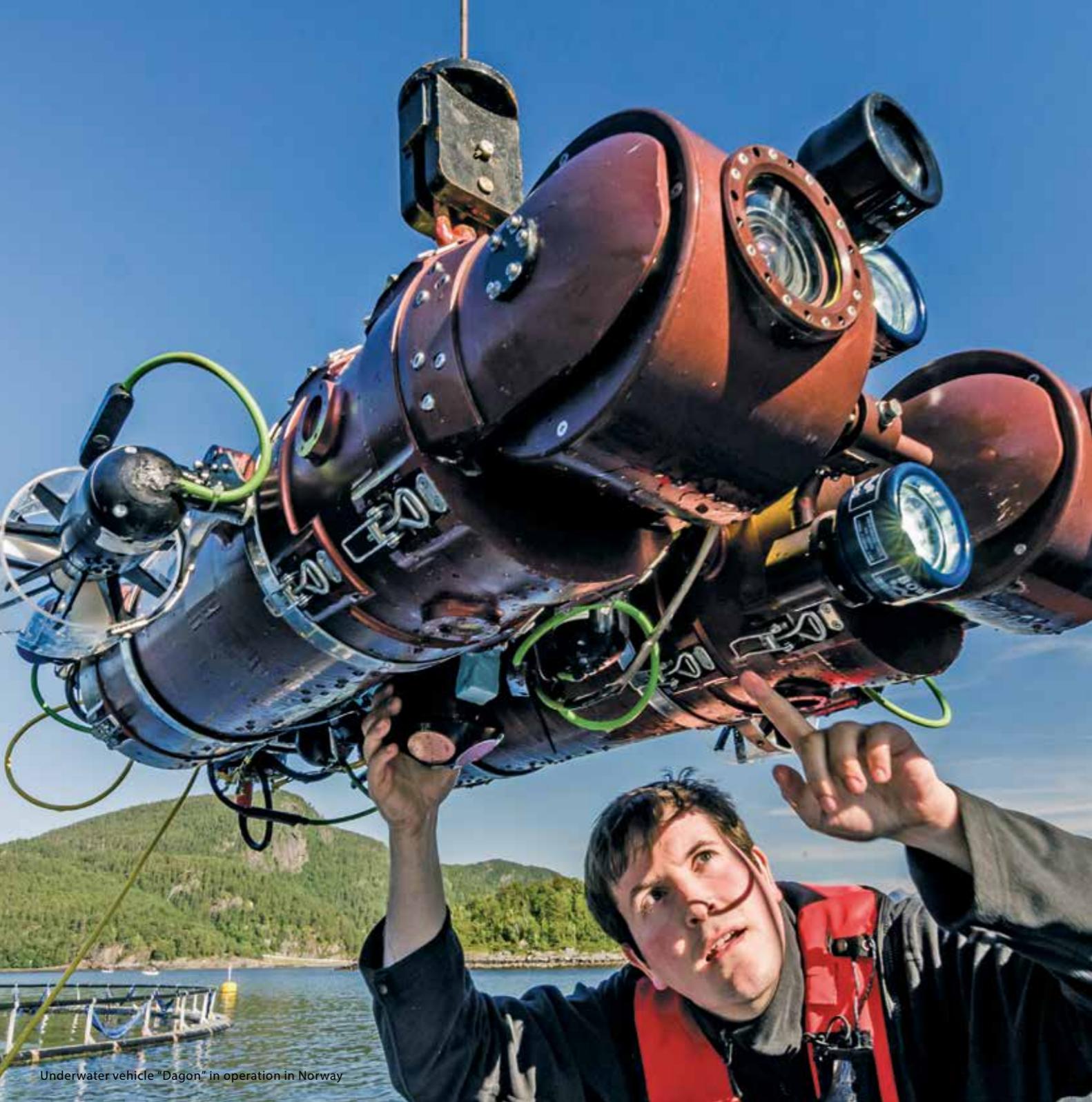


The “Micro-AUV” developed by DFKI researchers is one of the smallest autonomous underwater vehicles in the world



Our Range of Services Includes

- individual development of intelligent software solutions
- technology transfer of research results
- innovation consulting and scientific support
- market studies, expert reports and feasibility studies
- renting the Maritime Exploration Hall
- inspection of vessels and supply facilities such as coal-fired power plants
- complex, massively parallel embedded system solutions



Underwater vehicle "Dagon" in operation in Norway

The Maritime Exploration Hall was co-funded by:



European Union
„Investing in your future“
European Regional
Development Fund

Publisher: DFKI GmbH
Editing: Daniela Menzel
Design: Annemarie Hirth, David Schikora
Illustrations: Annemarie Hirth, David Schikora,
Jan Albiez, Stefan Haase, Studio Banck

We look forward to hearing from you!

**German Research Center for
Artificial Intelligence GmbH (DFKI)**

**Bremen Site
Robotics Innovation Center
Director: Prof. Dr. Frank Kirchner**

Robert-Hooke-Straße 1
D-28359 Bremen
Phone: +49 421 178 45 - 4100
E-mail: robotics@dfki.de



www.dfki.de/robotics