Lernende Systeme
GERMANY'S PLATFORM FOR ARTIFICIAL INTELLIGENCE

APPLICATION SCENARIOS FOR AI

Autonomous underwater vehicles

Starting point

There are already more than 1,300 offshore wind turbines dotted along Germany's coastline, with more currently being built. Their foundations reach down to 50 metres below the water's surface. This presents a challenge during inspections, servicing and repairs, making work on underwater structures elaborate, expensive and dangerous for the divers involved.

Within a few years, self-learning robotic assistance systems could help humans to inspect, service and repair offshore turbines and other underwater infrastructures. These autonomous underwater vehicles (AUVs) deploy Artificial Intelligence methods.

Application scenario

An underwater robot is deployed at sea to service an offshore wind farm. It navigates independently to the designated turbine and then inspects it as planned. The AUV can carry out some minor tasks on the spot, requesting assistance for major repairs. Once finished, the robot returns to an underwater dock where the data obtained can be evaluated.

Autonomous travel

Once the AUV is released from a ship, it automatically navigates to the offshore turbine, guided by distinctive features such as pipelines or other underwater structures. While in motion, the AUV uses its on-board sensor systems to circumvent obstacles or update its map. Online learning algorithms use the gathered data to improve the system's behaviour.

On-the-spot inspection

After reaching its destination, the AUV examines the turbine as ordered, performing in-depth navigation and planning steps. Once the inspection is completed, the mission is compared with the original plan, concluding how things could be done better in the future. The AUV can carry out minor taks by itself, but for major repairs it requests (either independently or with the aid of expert personnel) assistance from specialist maintenance vehicles or divers

Learning for the future
After conducting the inspection, the AUV can remain underwater as a 'subsea resident'. It makes its way independently to an underwater dock, where a system diagnosis and maintenance are carried out and the batteries recharged. The AUV is then ready for its next deployment, which is initiated by the control centre sending the mission data. Meanwhile in the dock, the system's behaviour is optimised with the help of learning processes based on the collected data, which can be incorporated into the further development of new vehicles and combined with findings from other areas of knowledge. In addition to this, maintenance and inspection specialists can use the data to trace how missions went and to integrate further knowledge and experience into planning algorithms (teaching).

Benefits

Self-learning systems can revolutionise work on underwater structures.
- **Stability:** Self-learning robotic assistance systems can predict and compensate for subsystem outages.
- **Cost effectiveness:** AUVs make the inspections required on underwater infrastructures more cost-effective and render difficult missions possible.
- **Safety:** The operation of underwater infrastructures will become safer and more sustainable as a whole. At the same time, deploying AUVs reduces health risks for specialist personnel (most notably divers).

Challenges

The following issues need to be clarified before underwater systems can autonomously carry out maintenance and repair work:
- **Liability:** Who is liable in the event of damage, and how can operators insure against damage?
- **Dual use:** How can the misuse of the systems be excluded?
- **Lerning methods:** How can we create parameters for targeted learning?
- **Transfer:** What is needed to transfer and generalise learning?

What nedds to be done?

The following steps are necessary if this application scenario is to become a reality within a few years:
- Promote development of technology until it reaches market maturity
- Resolve technical/scientific issues related to system enablement
- Develop test infrastructures, including real-life test fields at sea

The "Autonomous underwater vehilces" application scenario was developed by the Hostile-to-Life Environments Working Group of Plattform Lernende Systeme.You can learn more about this application scenario at www.plattform-lernende-systeme.de

Legal notice
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