Research with ultrasound saves lives and protects nature

The CIUS research centre, which is a centre for research-based innovation (SFI), uses ultrasound to detect heart defects in unborn children, monitor shipwrecks that leak mustard gas and to examine the health of farmed salmon. With the help of research and innovation, ultrasound technology can solve countless societal problems.

The CIUS research center has developed advanced ultrasonic techniques to detect cracks, corrosion and other potential weaknesses in pipelines and structures. This is critical for preventing accidents and environmental disasters, such as the Deepwater Horizon explosion. Photo: United States Coast Guard.

Norway has a long history as an ultrasound technology pioneer, especially in the maritime sector and medical imaging. This leading position is the result of innovative research, close collaboration between academia and business, and a strong willingness to invest in technological development.

CIUS (Center for Innovative Ultrasound Solutions – for health care, maritime, and oil & gas industries) is a world-class research center in ultrasound technology. They are at the forefront of innovation spanning the oil and gas, healthcare, and marine sectors. The centre was established in 2015 and has received NOK 96 million in funding from the Research Council of Norway.

"Research centers such as CIUS act as a bridge builder between theoretical knowledge and practical application, ensuring that Norway remains at the forefront of global developments in ultrasound technology," explains Svein-Erik Måsøy, researcher and head of CIUS.

From cradle to grave

Ultrasound is probably best known as a medical tool, and something many people associate with examinations during pregnancy. But ultrasound can be used for far more, and CIUS has contributed to new advances in diagnostics and treatment using ultrasound. From being able to better detect heart defects in unborn children to diagnosing and monitoring heart disease in adults, ultrasound technology has provided new opportunities for more precise and faster interventions and treatment.

"Heart disease is still a leading cause of death globally. Over 1 percent of the world's children have congenital heart defects. It is a health condition that requires lifelong treatment. Therefore, it is important to detect heart disease early in fetal life, so that we can prepare, plan and implement measures when the baby is born. We say "from cradle to grave", since we work with ultrasound technology throughout human life. From the fetal stage to old age," says Måsøy.

When diagnosing a heart attack, subtle changes in the movement of the heart muscle can provide information about the size of the infarction and the extent of muscle damage. With the help of research, we can obtain sharper and clearer images regardless of the patient's anatomy – a vital improvement in the diagnosis of myocardial infarctions and their severity. Photo: CIUS

Further work with adult patients has led to new advances and new opportunities for the diagnosis and monitoring of heart disease. A project in CIUS has led to the commercialisation of new technology to improve images of the heart. The technology optimizes the image quality of the individual patient. It is completely new and can be used, among other things, to create detailed images of the movements of the heart valves. The technology is already in use in thousands of systems worldwide. This provides doctors with better information and insight during the assessment and treatment of myocardial infarction or heart failure.

How ultrasonics secures the oil and gas sector

CIUS plays an important role in the transition to a more sustainable energy future in the oil and gas industry in Norway, including through the use of non-destructive testing. Non-destructive testing is various ways of detecting defects or weaknesses on objects without damaging the object you are testing on. The center has developed advanced ultrasonic techniques to detect cracks, corrosion and other potential weaknesses in pipelines and structures. This is critical for preventing accidents and environmental disasters.

"Ultrasonic sensors are used to map hundreds of kilometres of gas pipelines on the seabed. The sensors image every inch of the pipelines and are able to identify corrosion and damage. The work is an important part of the maintenance strategy for the network of pipelines transporting gas to the continent. This helps both to ensure the integrity of the infrastructure and to maintain Norway's position as a reliable energy supplier," says Måsøy.

Yasin Yari is working on his PhD on ultrasound and machine learning for smart monitoring of maturation stages in Atlantic salmon. Here he scans a fish using ultrasound. Photo: CIUS

The fate of warships as an environmental risk

During World War II, several ships were blown up or shot down. These wrecks, often loaded with hazardous materials, pose an environmental risk since they can leak toxic substances such as mustard gas. Ultrasonic technology, through the use of sonar, is used for the monitoring of these wrecks and the potentially hazardous substances they contain.

"With the help of ultrasound technology, we can map and monitor the condition of the wrecks. At CIUS, we have researched and further developed how such images can be made even more detailed. This makes it possible to better monitor the sunken ships and the surrounding sea areas and give us good tools for early warning, so that we can protect marine ecosystems," explains Måsøy.

Sustainable fisheries through precise stock monitoring

Ultrasound is also used in fisheries, where the technology contributes to more precise stock monitoring. With the help of ultrasound, researchers can estimate the size of fish stocks, which makes it possible to set catch quotas that ensure sustainable exploitation of fish resources. This work is crucial for protecting fish stocks from overfishing, and ensuring that future generations will also have access to these valuable resources. In CIUS, work has been done on new sensors that, among other things, can improve the detection of fish. They also benefit from ultrasound in the aquaculture industry.

"In the aquaculture industry, we work with research to improve fish health through the use of ultrasound. We have developed methods to use ultrasound to monitor the condition and health of farmed fish, including early detection of diseases and assessment of fish growth and development. These innovations will be able to help farmers make better-informed decisions to promote animal welfare and increase productivity in the fish farms," says Måsøy

Keeping Norway at the top with the next generation of researchers

42 PhD students have graduated from CIUS. The education of PhD students is an investment in the future of the scientific field and society in general. By investing in these young researchers, Norway is investing in its own future – a future that is rich in innovation, economic growth, and solutions to important societal challenges.

"The collaboration between research and business, supported by institutions such as CIUS, is crucial for developing new technologies that can meet the challenges of today and of tomorrow. By working with innovation, Norway can maintain its leading position in ultrasound technology, help solve global health and environmental challenges, and secure the country's economic future in a time of rapid technological change," says Måsøy.

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