



# SUBSEA

NEXT GENERATION INSPECTION,  
MAINTENANCE AND REPAIR

## WHO BENEFITS?



"We deliver solutions of ever improving Subsea Production Systems. We therefore support the development of remote intervention techniques which are more advanced, more cost effective and independent of weather conditions."  
- Brede Thorkildsen,  
Chief Engineer, TechnipFMC



"Our research enables autonomous systems to operate under water. The next step is implementation in real systems."  
- Ingrid Schjølberg,  
professor NTNU



## Partners



The project partners have addressed the challenge of localization and risk management. Our research makes it possible to switch between remote operator and local system control. This is an important stepping stone towards the ultimate goal: fully autonomous systems in the ocean space.

# KNOWLEDGE FOR A SUSTAINABLE OCEAN



Close cooperation between man and machine has been crucial for the success of unmanned space missions. There may be nobody on-board, but people continuously monitor each operation. Their task is to intervene when necessary. The vision of NextGenIMR is to bring this proven way of working into subsea operations, from outer space to ocean space.



Vehicles, which operate underwater today, are connected to a ship by a tether. This demands a ship, people on-board and good weather conditions.

In the future, subsea inspection, maintenance and repair operations will be smarter, safer and cheaper. This means no ship and no cable, but underwater vehicles, which solve tasks autonomously.

When man and machine work in harmony, we find the best of both worlds. This research is an important stepping stone towards the ultimate goal: **Fully autonomous systems in the ocean space.**



NextGenIMR produces research on robust localization and perception, collision-free motion planning and autonomy for IMR services that meet oil companies and subsea equipment suppliers need for efficient, reliable and safe subsea inspection and intervention.

**NextGenIMR**

### How do we create the next generation IMR?

Working close to subsea installations carries high risk. Knowing the exact position of the vehicle is critical to navigating and carrying out tasks autonomously and safely. Risk management calls for buffer zones as applied in air traffic management.



**Localization for safe underwater intervention**  
For autonomy, you need to know the location of the vehicle both accurately and reliably.  
"My research mathematically proves that we can find the position and orientation of the ROV"  
- Bård Bakken Stovner, PhD Student



**Design solutions for subsea factories to accommodate autonomous IMR operations**  
"My research is to develop control algorithms enabling the ROV and the human to cooperate when working on subsea-installations."  
- Eirik Hexeberg Henriksen, PhD Student



**IMR Design guidelines for safe autonomous operations**  
"I am working on risk management. Buffer zones. You can compare it to aviation. You adjust your motion according to position, traffic, installations and tasks."  
- Jeevith Hegde, PhD Student

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**NextGenIMR**



### What is new?

We design autonomous systems for multiple operations. People are monitoring, and if necessary interfere and stop the operation. In the future, the operator can be placed on-shore, following and interacting with the operation.

Therefore we call it the best of both worlds – humans sharing control with the autonomous system.

Total budget: 20 MNOK (2014 - 2017)  
Norwegian Research Council, industry (80% / 20%)  
Partners: NTNU, SINTEF, TechnipFMC and Statoil  
Contact: [ingrid.schjolberg@ntnu.no](mailto:ingrid.schjolberg@ntnu.no)



**NextGenIMR**