Complete Subsea oil-water Separation

Beatrice Daniel Issara*, Christian Holden* and Sigbjørn Sangesland*

**Norwegian University of Science and Technology (NTNU), Department of Mechanical and Industrial Engineering (beatrice.d.issara@ntnu.no,& christian.holden@ntnu.no)*
***Norwegian University of Science and Technology (NTNU), Department of Geoscience (sigbjørn.sangesland@ntnu.no)*

Large amounts of water are associated with oil production, especially in mature fields. Produced water is associated with increased costs because of water handling and transportation problems. It is therefore desired to separate out the water and get rid of it as early as possible through discharge to the ocean or through injection to the subsurface. For both release methods, there are strict environmental requirements of the concentration of oil in water. Due to the compact nature of the equipment required subsea, the residence time is low and hence control of the process is difficult.

The main objective of this study is to improve the control system of the subsea separation. This is done on a complete oil water separation system which consists of a combination of the bulk oil-water separation using multiple parallel pipe separator (Skjefstad & Stanko, 2019) and produced water treatment using de-oiling hydrocyclones (Vallabhan, et al., 2022). The two systems are connected by a Typhonix low shear coalescing pump which increases the size of the oil droplets hence improving the separation efficiency of the hydrocyclones (Husveg, et al., 2019). While the individual systems have been studied separately, limited work has considered the dynamic interactions and holistic control of the integrated system.

This study develops a control-oriented model from first principles which will be used in the process of creating a holistic control architecture for the separation system. Simulations of different control architectures will be performed and a study to find the optimal control scheme. The results will be compared to the experimental results from the rig which is under construction at NTNU (Nørgaard, 2023). This rig will be operational in June 2026. The expected outcome is a validated control-oriented model and an optimal control scheme for the complete separation system.

References

Husveg, R., Husveg, T. & N. van Teeffelen, M. O. M. R. H., 2019. Automatic Operation and Control of a Novel Coalescing Centrifugal Pump for Improved Oil/Water Separation. *SPE Production & Operations.*

Nørgaard, M., 2023. *Design of a test facility for oil-water separation and water treatment,* Trondheim : Norwegian University of Science and Technology.

Skjefstad, H. S. & Stanko, M., 2019. *Development and assessment of a multi-pipe oil-water bulk separator concept for subsea applications,* Trondheim: Norwegian University of Science and Technology.

Vallabhan, M., Holden, C. & Skogestad, S., 2022. Deoiling Hydrocyclones: An Experimental Study of Novel Control Schemes. *SPE Production & Operations,* pp. 462-474.