



# Analysis of the PLAT-O Taut-moored Platform

Validation of  
ProteusDS tidal energy  
platform simulation



Client:	Sustainable Marine Energy
Location:	European Marine Energy Centre (EMEC) / FloWave Tank
Capacity:	PLAT-O 100KW 1st generation platforms PLAT-O 200KW 2nd generation tidal platforms
Scope:	Support SME to develop a model to predict the motions and loads on the PLAT-O platform and compare with tank test data

## Dynamic Systems Analysis Ltd.

DSA supports the marine renewable energy industry through the development of custom software solutions for the most challenging engineering analysis problems. DSA's ProteusDS and ShipMo3D simulation software tests virtual prototypes of vessels and equipment operating in harsh ocean conditions.

Virtual prototypes enable the tidal energy industry to answer questions related to engineering design, planning, training, operations, and safety. Understanding the dynamic effects of ocean current, wind, and waves can significantly reduce the risk and uncertainty associated of vessel motions and loads on equipment in an ocean environment resulting in safer designs and lower risk and project cost.

## Sustainable Marine Energy

Sustainable Marine Energy Ltd (SME) is a marine engineering company, focused on bringing cost-effective solutions to the tidal energy market. SME is aiming to deliver the next generation technology that will challenge the current tidal energy industry on price and performance. Based in Edinburgh, SME is at the hub of many marine renewable developments in the UK.

PLAT-O is SME's tidal platform, designed to host 3rd party tidal turbines that will generate power from one of the Earth's most abundant and reliable renewable energy sources, the tide. PLAT-O provides a reduction in the cost of tidal energy by using smaller, modular systems and offers an enhanced yield due to its optimum position in the water column.

## Background

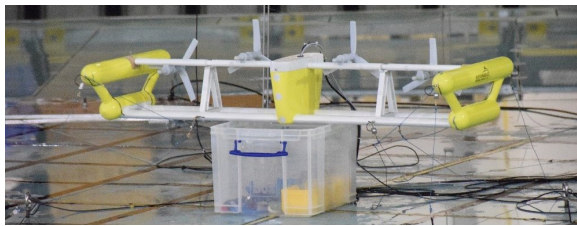
Predicting the motion of tidal support systems is critical for device development and deployment. Considerable research and industry study has been conducted investigating the performance of the tidal turbines themselves but there has been less investigation into the support structures. SME tested the first full scale PLAT-O at the European Marine Energy Centre (EMEC) in 2016, and the platform is scheduled for full deployment in early 2017. Development of the second-generation device PLATO-O#2 has been conducted since 2015 and uses the same concept as PLAT-On 1 but will mount four individual turbines instead of two as seen on the first-generation device.

The PLAT-O 2 1/17 scale model was tested in tank tests at the FloWave Tank in Edinburgh in April 2016. The model was tested in axial flow up to full-scale speeds of 4.5m/s. The platform was tested in both normal operating conditions and in line-loss conditions. In the project considered here, the scaled results were compared to simulations created in ProteusDS software of the full-scale platform. This was done to determine the accuracy of modelling the platform behaviour and mooring line tensions in ProteusDS.

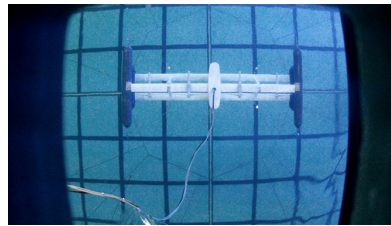
## Challenges

PLAT-O is designed as a taut-moored platform, which operates by balancing the buoyancy and drag forces on the system, using anchors and mooring lines. It is vital to understand the performance of the platform, i.e., how the system pitches, rolls, and yaws. The platform motion directly affects the loads on the mooring lines and anchors, which in turn affects the cost of the system.

Floating tidal platforms like PLAT-O are subjected to significantly complex loading, due to the dynamic wave interaction and turbulent tidal flow. The combination of multiple types of loading results in motions that can be complicated to predict.



Four Schottel In-stream Turbines (SITs) mounted on PLAT-O#2 at 1/17 scale



Platform orientation testing at FloWave in Edinburgh, Scotland



Two (1st gen) SITs mounted on PLAT-O at full scale

## Outcomes

The ProteusDS simulations were carried out at full scale, with drag coefficients comparable to tank scale using Reynolds scaling, and then compared to scale model results. The mooring line loads predicted by ProteusDS were very accurate at lower speeds, while slightly over predicted (<5%) at higher speeds. The platform pitch and roll was also overpredicted slightly in ProteusDS at higher speeds. The over predictions are attributed to: drag scaling effects that may not be accounted for in the Reynolds scaling of the drag coefficients; surface anomalies that may contribute to drag in the tank model; and the lack of interaction between components in the numerical model. The analysis of the PLAT-O#1 system is intended to determine whether these effects are reduced at larger scales.

In addition simulations of line failure accurately predict the loads exerted on the anchor and the extreme orientation that the platform may adopt. Both the simulations and tank tests show that even with an extreme attitude, the system is stable and does not move enough for damage to be a consideration.

## Conclusion

ProteusDS was successfully used to model the Plat-O taut-moored tidal platform. The balance of buoyancy, thrust and mooring loads were successfully simulated and the results were validated against tank tests. For more information see: P. Jeffcoate, F. Fiore, E. O'Farrell, D. Steinke, A. Baron, R. Starzmann, S. Bischof, "Comparison of Simulations of Taut-Moored Platform PLAT-O using ProteusDS with Experiments", Proceeding of the 3rd Asian Wave and Tidal Energy Conference (AWTEC), Singapore, Oct 24-28, 2016

\*Images provided by Sustainable Marine Energy.