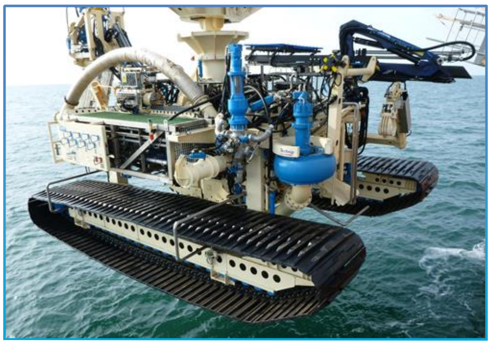
Technische Universiteit Delft

Offshore & Dredging Engineering

Mobility of Subsea Tracked Equipment

The Offshore wind industry harvests energy in offshore locations, using large turbines to convert this energy to electrical power. The electricity is gathered and transported to shore via cables. These cables need to be protected from external hazards that could result in damages and thus economic losses. Generally the cables are buried in the seabed or covered with solid objects like rocks or concrete matrasses. For cable burial a trench needs to be created in the seabed, this process is called trenching.
Tideway acquired a trenching vehicle to enable provision of a wider range of cable protection solutions besides rock placement. Instead of more familiar trenching ploughs, this machine is equipped with a track drive and is self-propelling. To create trenches the vehicle has two options, mechanical cutting and jetting.



Expected progress rates of the vehicle are to be determined to make a more realistic assessment of the expected project durations in the pre-execution stages. This can only be done if specific knowledge regarding the interaction between seabed soils and track drive is available. Further-more it is interesting to look at the most optimal setup of the vehicle for each project, make the machine work more efficiently and decrease the trenching duration.
The current thesis proposes a model that can assess the trench production rates for a tracked trenching vehicle. Inputs for the model are CPT results, operational conditions and general vehicle specifications. Furthermore, the model considers the fact that the vehicle has a limited amount of power onboard. The sensitivity of the model parameters and impact on production is analyzed via a tool created specifically for Tideway's subsea trencher.

The project is based on a review of literature regarding soil mechanics, soil cutting and Terra-mechanics. Using this knowledge the model is developed considering a rest state and a steady driving state of the vehicle. The final model incorporates several sub-models, accounting for the resistant-, thrust forces, slopes and more. Phenomena as shear displacement and slip are incorporated and build towards the output for the model, a forward speed of the vehicle while cutting. The model can include seabed slopes and layered homogeneous soils. The presence of boulders, currents and effects of acceleration/braking are outside the scope of this thesis.
Based on the developed model a software algorithm is developed in the open-source programming language Python. This algorithm generates a working area which indicates the zone within which all operational and machine boundaries are fulfilled. Additionally an optimal working-point is also suggested. This point corresponds to the given combination of operational and vehicle specifications, where the machine operates at a desired efficiency.

Several conclusions are drawn, accompanied with recommendations regarding optimization of the model and industry procedures. The goal of thesis has been achieved, by developing the model and the tool. A validation process based on measured field data shows that the several (sub)models are within range of the measured data.

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