European Defence Fund Project: digital ship sTructural Health mOnitoRing dTHOR

Postdoc position on Electrochemical Impedance Spectroscopy as a Predictive Tool for a Ship's Hull Corrosion Integrity

Key words

Corrosion protection; coatings; electrochemical impedance spectroscopy; modeling; lifetime prediction

The project

Within the dTHOR (digital ship sTructural Health mOnitoRing) project of the European Defence Fund, the aim is to develop next generation predictive Ship Structural Health Monitoring (SSHM) systems based on a digital framework complying with innovative utilisation of large amounts of load and response measurements from advanced sensor systems, and hybrid analysis and modelling (HAM) which combines physics-based and data-driven (AI/ML) models. These tools will be applied to achieve interoperable and evolving models facilitating a game change for SSHM.

One of the most important cost drivers and availability killers for a ship's hull is corrosion. Within the framework of dTHOR, in order to predict the location, severity and consequences of corrosion damage, it is essential to monitor the state of the protective coating system. Electrochemical impedance spectroscopy (EIS) is an electrochemical tool that is well suited for this purpose. This project therefore aims to investigate the applicability of EIS as a form of condition monitoring and to understand the evolution of specific EIS parameters over time.

Currently, much experience already exists with the relationship between coating condition and EIS data, e.g. the Bode plot. Using equivalent circuits, it is possible to quantify multiple different coating characteristics, including barrier properties and adhesion. It is therefore also possible to rank the corrosion protective condition of multiple comparable coatings of different ages. In reality however, a large variety of coating systems exists, with different chemical composition and functionality. This

variety of coating systems will age differently, with a variable response to changing operating conditions and local damages. This is especially true in the presence of active corrosion inhibiting coatings. The remaining challenge is therefore the translation of the knowledge of specific EIS aging characteristics of standard coating systems into the remaining useful life of more complex coating systems, both damaged and in pristine condition, under various different loads. For this purpose, the next step in this project is to develop a degradation model that describes the degradation development over time, including variable loads, damage states and corrosion inhibition. With this knowledge, each EIS measurement could result in a reliable, updated lifetime prediction. Additionally, it could be possible to predict the effect of changing operational conditions onto the future corrosion protective properties of a coating system.

Candidate profile

The ideal candidate should combine a strong affinity with electrochemistry with reasonable modeling skills. The candidate shall have a critical attitude and the ability to combine different fields of technology.

The candidate shall start as soon as possible. The candidate will be employed as a Postdoc candidate by Delft University of Technology (TU Delft) for a duration of 3 years.

A security screening is mandatory for this project. Application is only open for candidates from EU and / or NATO membership countries.

Supervision

The NLDA and the Corrosion Technology and Electrochemistry (CTE) group of TU Delft will supervise the candidate together. The candidate is to be based at the NLDA and/or at TU Delft.

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