Corrosion Modelling, Cathodic Protection Design and related Electromagnetic fields prediction with FLUX.

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Cathodic protection systems - Impressed Current Cathodic Protection (ICCP) systems or sacrificial anodes - are used to prevent corrosion of underwater structures. Their behaviour is basically the following: anodes (zinc blocks or anodes connected to an electric generator) are added on the surface to produce in the sea water a current in order to polarise the materials to a «cathodic immunity» potential range. The current loops back to the structure through its inner metallic parts. These protection currents produce, as well as the natural corrosion currents, an electric and magnetic field around the structure, making military ships prone to detection.

FLUX and the application "Electrolysis"

Through a contract with GESMA (Groupe d'Etudes Sous-Marines de l'Atlantique), CEDRAT implemented in FLUX a new application called "Electrolysis" to model the cathodic behaviour of an underwater structure with or without a cathodic protection system -ICCP or sacrificial anodes- and the associated electromagnetic fields produced in the sea water around the structure.
For such a computation, the user will input polarisation laws of materials (generally non linear function between the normal current density and the potential drop between the material and the sea water) and the anodes parameters (imposed current density or potential). FLUX computes the electric conduction either in the sea water, in the inner metallic parts of the structures or both.

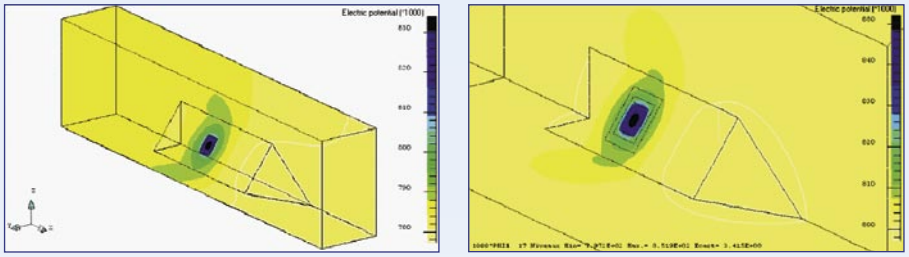
There are then 2 cases:

- *If the electric conduction is computed only in the sea water:*

As a first approximation, the potential in the structure can be considered as constant (it is set then as the reference = zero). Indeed, the structure is a better conductor than the sea water.

- *The electric conduction is computed also in the structure:*

The potential in the structure can be considered as varying. Then, the inner parts of the ship (essentially the deck and the conductors) as well as the insulators of the anodes will be defined in the geometrical model.



Comparison of the electric potential in the electrolyte around the anode without and with accounting for the shell current.

Results

From those computations, the user can get various results:

- The potentials and current densities in the structure and in the sea water,
- The electric field in the sea water,
- The magnetic field due to the currents flowing in the sea water, in the inner structure or both, computed in and outside the sea water by Biot and Savard's law.

Some words about GESMA

GESMA (Groupe d'Etudes Sous-Marines de l'Atlantique) is the technical reference centre of DGA (Délégation Générale pour l'armement) for the ships underwater electromagnetic signatures expertise (EM signatures related to ferromagnetism, EM signatures related to corrosion and EM signatures due to on board electric devices and networks). GESMA carries out measurements and analysis of the electromagnetic signatures of surface vessels and submarines for the benefit of the fleet support service of the French Navy and the Naval Programs Department of DGA.

Corrosion marks on the underwater structure of a ship.

Release of the first MESEMA News Letter.

Mesema is a Specific Targeted Reseach Project within the thematic priority of Aeronautics and Space of the 6th Framework Programme of the European Commission. MESEMA stands for «Magnetoelastic Energy Systems For Even More Electric Aircraft».
As an active member of this project, CEDRAT TECHNOLOGIES invites you to discover the other european partners, the contents of each work package and 3 articles introducing the technological aspects through the reading of this first Mesema Newsletter (***http://www.mesema.info***).

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