SOFTWARE SOLUTIONS FOR MARINE APPLICATIONS

Links to Main applications

Click on text and pictures

☑ Electric and magnetic fields computations >>>

Pioneering the field of computation of electromagnetic fields related to ships, FLUX has become a known and renowned reference in the world. It is one of the only software solution to provide a solver able to model both silencing systems and corrosion protection systems.

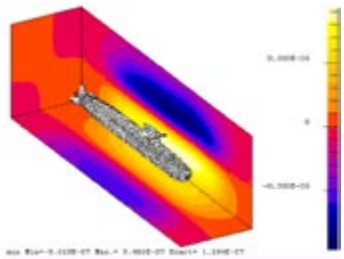
" We can now design our silencing systems with FLUX at the same time than the ship is developed, while previously we needed to wait nearly the end of the ship designing."
Laurent Demilier, Electromagnetic Silencing Study Engineer, DCN.

Magnetic signature and influence >>>

As the marine environment is increasingly understood and exploited, magnetic influence of human activity is more and more analysed. Various equipment may have a magnetic signature, such as subseas umbilicals, subseas productions systems, submarines... One of the most significant example is the magnetic signature of a vessel. As it moves through the water, the magnetic field generated by this huge piece of metal also moves and adds to the earth's magnetic field. Because of its distortion effects on the earth's magnetic field, the ship may then be detected by magnetic sensitive devices such as magnetic mines. To design silencing systems preventing the ship from detection, both very good knowledge of the field generated by the ship and great accuracy of the influence of degaussing coils are needed.

Finite Element simulation using FLUX provides both thanks to its advanced models:
- Infinite box to compute far fields,
- Thin surface regions to prevent from volume mesh in the hull,
- Reduced potential formulation for a better accuracy on magnetic anomaly.

Moreover, FLUX features many tools that make the simulation of vessels and marine equipment even easier:
- Large CAD import capabilities: DXF, STEP, IGES, CATIA, PRO/E, PATRAN, NASTRAN, ...
- Multiparametric capabilities,
- 64 bits compatible solver with FLUX 9.3,
- Advanced mixed mesh generator.



Scorpene SSK submarine and part of its load modelled with FLUX (Courtesy of DCN).

CRM and UEP computation >>>

Corrosion Related Magnetic field (CRM) and Underwater Electric Potential (UEP) are very useful pieces of information when designing cathodic protections. The application in FLUX called "Electrolysis" has been essentially developed 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. FLUX computes the electric conduction either in sea water, in the inner metallic parts of the structures or both.

"The FE method is used to predict the effect of degaussing current on reducing the magnetic signature of current vessels and to optimally design the degaussing coil system of future vessels."
Dr Marius BIRSAN, Defence Scientist, Defence R&D Canada Atlantic.

(Upper left picture, courtesy of DRDC)

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Links to Key features

Click on text and pictures

FLUX for EMI, machines and cables design

PSCAD for network analysis

CIVA^{nde} for Non destructive testing

CEDRAT

www.cedrat.com

☑ Non destructive testing >>>

Non Destructive Evaluation (NDE) is widely used to examine materials during the manufacturing or in process. In this context, simulation of NDE plays an increasing role for conceiving methods, demonstrating their performances at a low cost, teaching, training and providing help to operators. As simulation permits to master the parameters involved during an examination, it is a crucial factor to increase inspection reliability. CIVA^{nde} is a unique solution to simulate, postprocess (imaging and analysis) and compare virtually any type of ultrasonic and eddy current NDE device or process. It features, among others:

- library of predefined components (elbows, nozzles, ...) or CAD import,
- library of materials,
- large range of probes,
- phased array simulation,
- advanced signal processing tools...

Ultrasonic field transmitted by a wedge coupled probe within a nozzle.

" Phenomena occurring in both AC and DC ship subsystems (...) are successfully simulated in PSCAD, analysed and discussed, while the effect of certain critical parameters are investigated."
John Prousalidis (School of Naval Architecture and Marine Engineering, National Technical University of Athens).

☑ Power quality study >>>

The electric power grid of a ship can be regarded as a small scale industrial power system. A ship's electric energy system consists of a generator set and a distribution cabling system serving the loads. Increased electric power demands led to increased number of reasons for lower power quality. As it has been used for many years by energy facilities, power systems simulation is a very efficient way to improve the power quality provided to end users.

The PSCAD time domain simulator will help you to analyse the entire power system from the power supply to the loads. As an Electromagnetic Transient package, PSCAD is particularly adapted to hybrid systems modelling and transient analysis studies such as fault analysis and protection design, harmonic analysis, motor start up, pulsed load phenomena, speed variations...

An extensive library of predefined electrical models allows users to represent each part of the network. User can adapt the precision of each part of the system to the simulation objective:

- Generators,
- Transformers,
- Cables and Lines,
- Power Electronic Converters,
- and other type of components...

In addition to the standard library, user can easily design custom components interfaced to PSCAD in C, Fortran or Matlab standards.

Shipboard Power Quality simulation studies with PSCAD.

☑ References >>>

CEDRAT's solutions are worlwide references used in many organisations, such as:

Aker Kvaerner, DCN, Defence Research and Development Canada, DGA GESMA, Fincantieri Cantieri Navali Italiani SpA, Hellenic Naval Academy, KDD Submarine Cable Systems Inc, Kockums, Koninklijk Instituut Van de Marine, Laboratoire du magnétisme du navire, Naval surface warfare center, Naval undersea warfare center, Royal Netherlands Navy, School of Naval Architecture and Marine Engineering (NTU Athens), Wehrtechnische Dienstelle für Schiffe und Marinewaffen...

Marelec 2001: Ship magnetic modelization by finite elements.

Jean Pierre Dallet - DCN Ing CN.

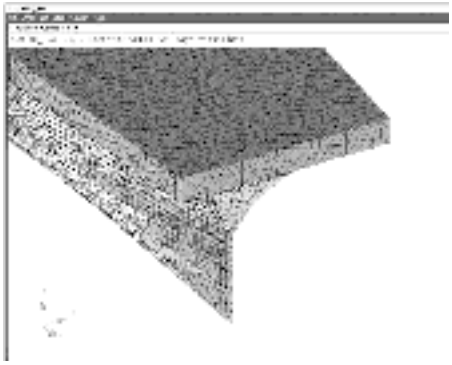
The Frigate Lafayette, the Aircraft carrier Charles de Gaulle, the Frigate Horizon, and the Future furtive frigates are actual and future military ships that benefit yet or will benefit in the future, of the magnetic modelizations by finite elements. Although the radar signature is well known by the general public, they don't really refer to the magnetic signature. And yet! This physical component is often used in the triggering systems! The German Navy was the first to use on a large scale this indiscretion source during the Second World War. That's why, from the end of the conflict, the French Navy appealed to Louis Néel to create in Grenoble, the Ship Magnetism Laboratory. So, he created an original and ingenious method of ships physical modelization "the wire mesh mockup". This method has been used until the end of the 80s.

Then, because of the former calculation means, it took a long time to the "Direction des Constructions Navales" (DCN) to launch in the 80s, an ambitious investigation program on the mathematical modelisation for the ships magnetic signatures. Moreover, some important works like Xavier Brunotte one's allowed to prove the feasibility of a ship magnetic modelisation thanks to the finite elements code "FLUX3D".

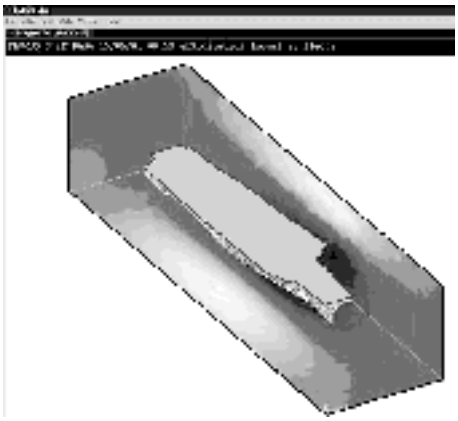
Several years later, after the industrialization and the validation of the method, the DCN decided to replace the physical modelisation by a mathematical method thanks to FLUX3D. Ever since, many ships have been using this method and the results have been increasing every day. Today, they are representative of the real signature better than 90%. Through an original tool (DATASSIM), FLUX3D can be used without any problem. No more long and fastidious descriptions of the ship! An Autocad interface enables to capture easily the data of the ship. A simple clic and the result appears in 3D!

The use of FLUX3D, in training more and more advanced in the magnetic signatures study, enables us to improve definitively our reaction time faced with the ship geometrical modifications. Moreover, it is perhaps the reason why a few years ago, James Bond (007) who was aware of the magnetic signature performances of the Frigate LaFayette decided to borrow it!

Jean Pierre Dallet
DCN Ing CN.

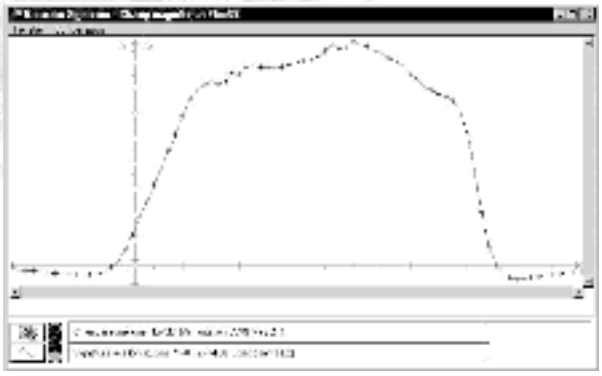


Detailed mesh of the aircraft carrier Charles De Gaulle.



Magnetic anomaly of the aircraft carrier Charles De Gaulle.

Aircraft carrier Charles De Gaulle.



Signature of aircaft carrier Charles de Gaulle has been designed using FLUX3D.