

EMPACT

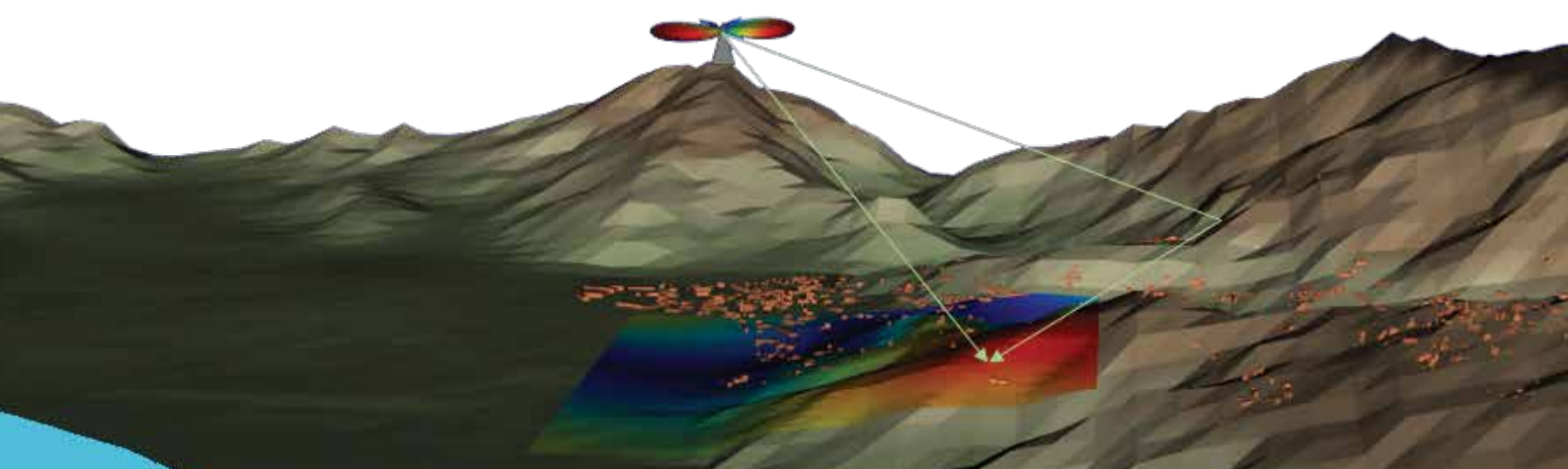
A Comprehensive Service
for ElectroMagnetic imPACT

THE SERVICE INCLUDES
**consultancy, design, prediction software and measurement
support for robust design of complex systems in harsh
electromagnetic environments**

EMPACT service relies on accurate methodologies based on the high frequency theories GO (Geometrical Optics), G/UTD (Geometrical/Uniform Theory of Diffraction) and PO (Physical Optics) implemented by means of a fully 3D ray-tracing algorithm to study the EM propagation in complex scenarios.

IMPACT SERVICE IS A RESULT OF A LONG TRADITION EXPERIENCE COMING FROM THE FOLLOWING MOST IMPORTANT PROJECTS

- **Base Stations Planning**
for cellular network in various cities such as **Viareggio, Lucca, Scandicci, Pisa, Pietrasanta, Forte dei Marmi, Camaiore (Tuscany, Italy)**
- **EM field levels evaluation and monitoring**
in the **Poligono Interforze del Salto di Quirra (Sardinia, Italy)**, study commissioned by **NATO Agency NAMSA**
- **EU SANDRA Project**
in collaboration with **Institute of Communication and Navigation DLR (Germany)** for **network planning of future communications in airports**
- **EMI analysis and prediction**
of wind farm in **Monti Albani** and in **Santa Luce (Tuscany)**



IMPACT has several capabilities for solving different problems in the applications summarized below.

CAPABILITY	EM SOLVER	APPLICATION
Outdoor propagation in urban scenarios and in large rural areas	Ray-tracing (GO, G/UTD), Knife Edge	Cell Planning for mobile systems, Check EM levels allowed by regulations
Indoor propagation	Ray-tracing (GO, G/UTD)	Wireless Lan Coverage
Channel Analysis	Ray-tracing (GO, G/UTD)	Channel parameters estimation and short range radio links
Antenna on Platform	Ray-tracing (GO, G/UTD)	Far and Near field installed antennas performance, RADHAZ, EMC/EMI
Fixed Radio Link Assessment	ITU Recommendations, PO	Long range point-to-point radio links

ESTIMATION AND MEASUREMENTS OF THE EM FIELD LEVELS

Free Space provides a complete service related to the monitoring of EM fields both through numerical simulations and measurements (broadband and narrowband).

Free Space is able to perform measurements in **outdoor and indoor environments (both military and civilian)** of EM sources operating **from 50Hz to 18GHz** and beyond, for assessing population and workers exposure (**HERP**) as well as **RADHAZ (HERF, HERO, HERA, HERE)**.



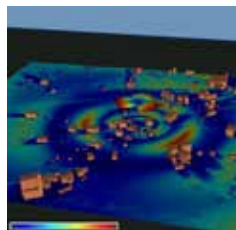
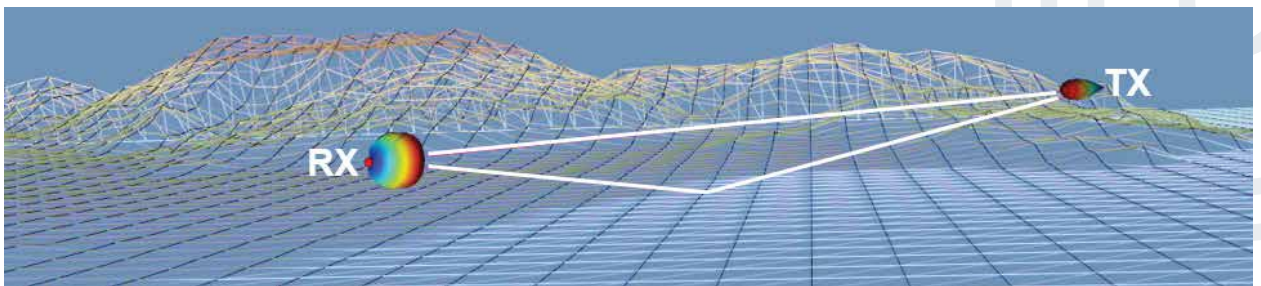
■ Photos of some measurement campaigns



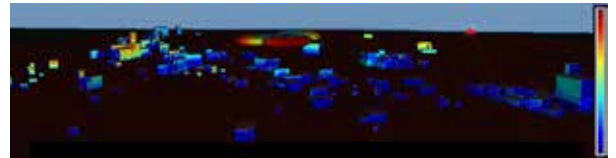
EMPACT can be used to optimize the number and position of the measuring points by identifying the most critical ones. Indeed, we are able to compute electric and magnetic fields in both far and near field regions of sources (i.e. **antennas**).

As a result of the synergy between simulations and measurements, the verification of both national and international regulations is efficient both in terms of time and cost.

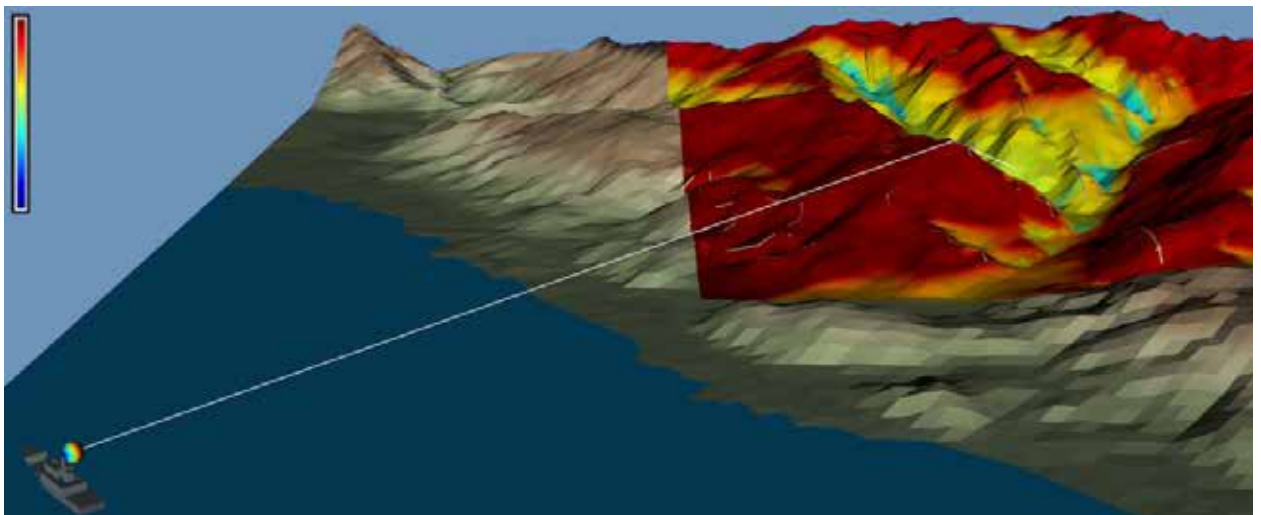
■ Measurement and simulation work process

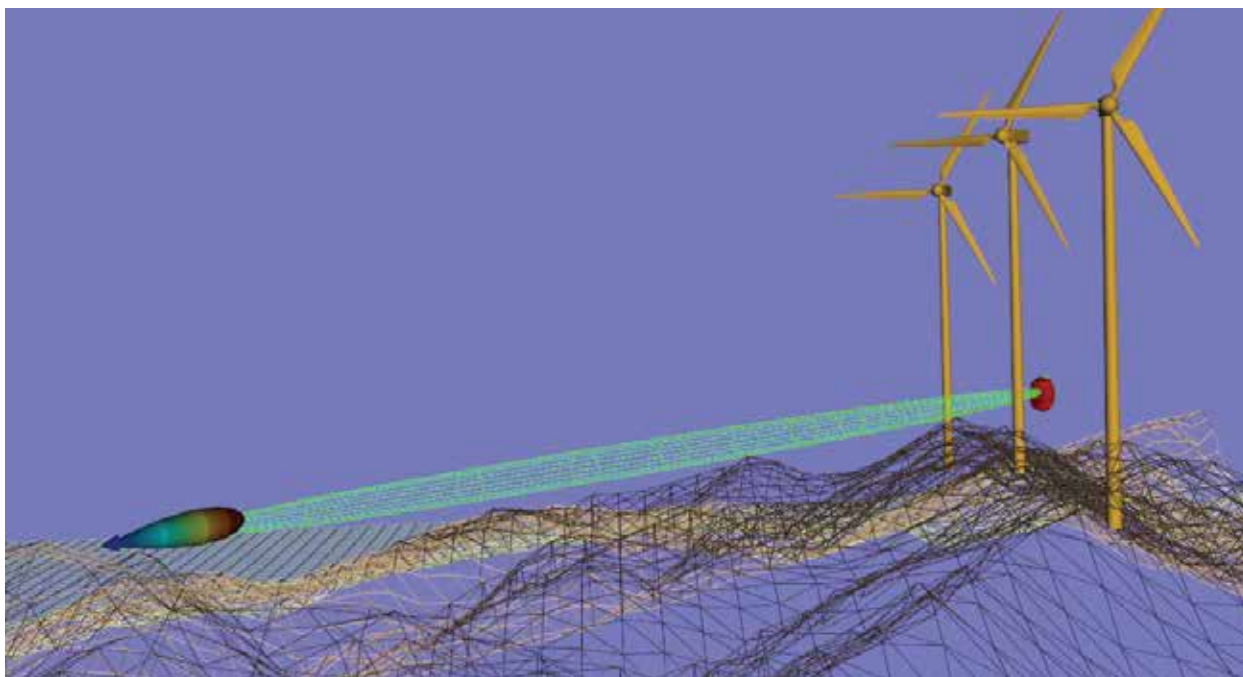


■ EMPACT: Electric field distribution in an urban scenario due to Base Stations for Mobile Communications.



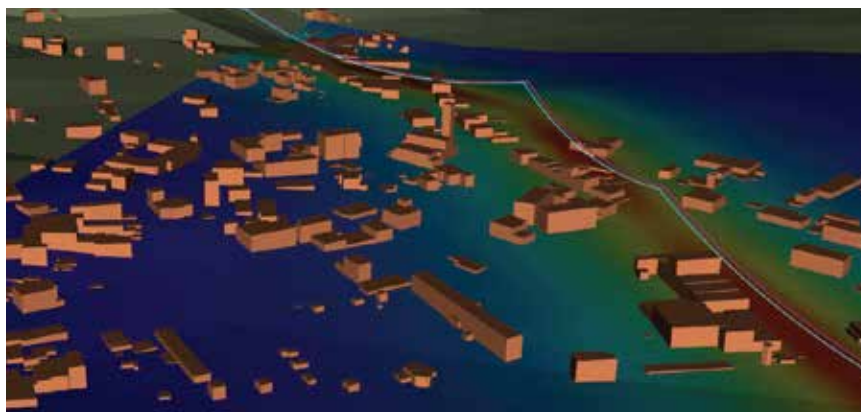
■ EMPACT: Propagation over large rural area.





■ EMPACT: Point-to-Point Radio Link assessment

EMPACT has also a dedicated solver, based on the fully 3D Biot-Savart Law, to compute the magnetic induction due to overhead (aerial) and buried (underground) power lines at **50/60Hz**.



■ EMPACT: Magnetic Induction evaluation due to power lines at 50/60Hz.

FREE SPACE IS ABLE, UPON REQUEST, TO PROVIDE
TAILORED SOFTWARE TOOLS AND CUSTOMIZED MODELS
FOR THE DIFFERENT AFOREMENTIONED PROBLEMS

EMPACT

A Comprehensive Service
for ElectroMagnetic imPACT – *Naval Expertness*

THE SERVICE INCLUDES
consultancy, design, prediction software and measurement support for robust design of complex systems in harsh electromagnetic environments

EMPACT is useful to naval designers at the early conceptual development stage up to acceptance tests of ships.

EMPACT HAS BEEN USED IN

- EMC studies on **naval units of the Italian and foreign Navies** providing assistance to the shipyards in defining the antennas topside arrangement and in the RADHAZ assessment

EMPACT provides electric and magnetic fields (**in both far and near field regions of the antennas**), Power Density, Received Power, AoA, AoD, Channel Frequency and Impulse Responses, Delay Spread etc.

Modern naval units are becoming increasingly sophisticated and complex, having to be able to operate in different missions and scenarios. Therefore, the complexity and the number of sensors and systems (communication, radar, EW, etc.) installed on board have also increased.

These systems, operating in a **harsh electromagnetic (EM) environment**, must perform their functions without interference and with minimal performance degradation.

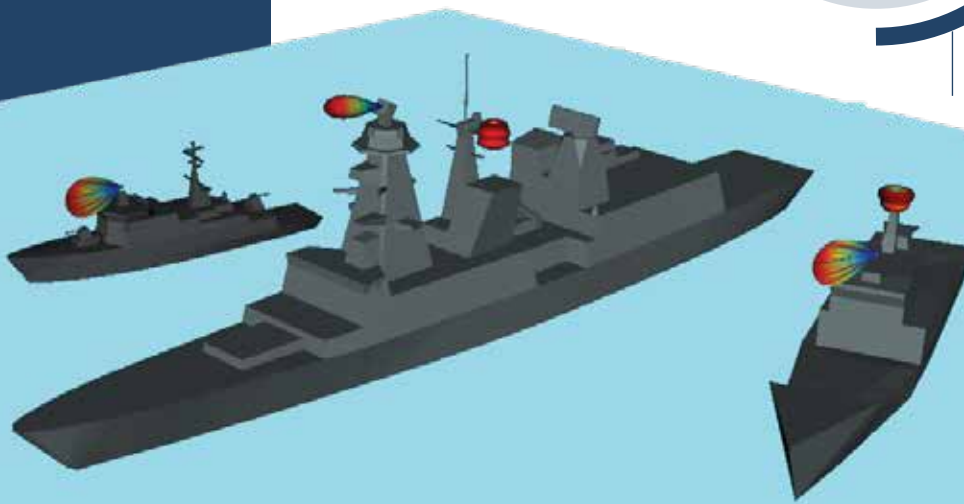
EMPACT can be used for on-board **EMC/EMI** analysis allowing the Risk assessment regarding:

RADHAZ
HERP, HERF,
HERO, HERA. HERE

**INSTALLED ANTENNA
RADIATION PATTERNS**
ALSO FOR LARGE PLANAR
ANTENNAS OVER ISM
(INTEGRATED SENSOR MAST)

EMPACT

RCS



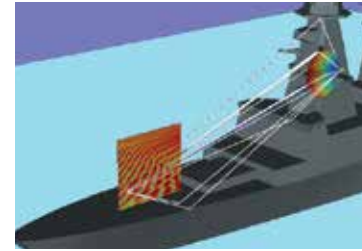
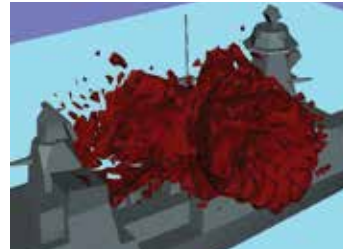
RADHAZ

The evaluation of the EM field levels plays a fundamental role:

- in the assessment of the exposure of **Personnel (HERP)**
- in the assessment of **flammable liquids and fuels (HERF)**
- in the assessment of **ordinances and ammunition (HERO)**
- for the verification of the **equipment susceptibility limits (HERE)**

IMPACT computes the EM fields in both near and far field regions of the sources (antennas).

■ Example of 3D HERP iso-surface due to an UHF antenna and HERO assessment due to a radar source.

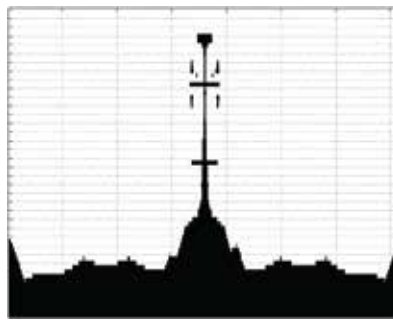
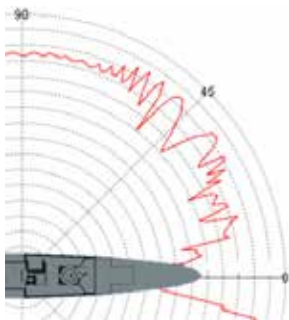


INSTALLED ANTENNA PERFORMANCES (ANTENNA ON PLATFORM)

Starting from the stand alone antenna characteristics **IMPACT evaluates the installed performance** (i.e. in the operative scenario) taking into account the presence of the ship topside structures (e.g. mast).

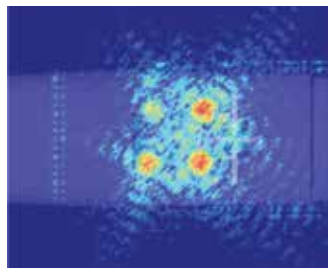
Radiation patterns, Gain, Shadowed Regions and so on can be rapidly computed in several antenna positions to determine the best trade-off between spatial constraints and performance.

■ Example of installed radar antenna radiation patterns and shadowed zones.



RADAR CROSS SECTION (RCS)

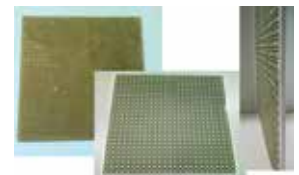
EMPACT has a module dedicated to the RCS evaluation that can be used during either the preliminary and either the final phases of the ship design. Starting from the naval CAD, EMPACT allows the calculation of the RCS **considering both the effect of the vessel geometry and the materials used.**



■ Evaluation example of ship RCS and hot spots

EMC/EMI/RCS RISKS MITIGATION

Once the EMC/EMI/RADHAZ analysis has been carried out Risk Mitigation actions involving **Radar Absorbing Materials (RAM), Decoupling Structures (Shields, FSS, etc.), Shaping and Operative Procedures** can be suggested.



■ Some absorber prototypes.