CEM SOLUTIONS IN AUTOMOTIVE
Computational Electromagnetics for smart, safe and connected vehicles

KEY BENEFITS
- Extensive use of hybrid techniques to handle realistic scenarios
- Building fully equipped industrial models in their early design stage: full car body with components, cables, wiring and equipment, antennas, sensors
- Continuously enhanced simulation process to increase resolution speed and ease-of-use
- Dedicated processes for easier cleaning and meshing stages of poor geometrical models
- Very wide frequency spectrum ranging from radio-frequency to millimeter waves
- User-friendly interface hosted on a multi-domain platform shared by thousands of industrials customers worldwide
- Automatic processing and full reports generation based on user-defined templates

INDUSTRIAL APPLICATIONS COVERED IN THE AUTOMOTIVE SECTOR
- Immunity or Susceptibility (EMS) to external electromagnetic aggressions
- Electromagnetic Radiation of onboard electronics and wiring
- Interference between internal components, cross coupling
- Virtual Anechoic Chamber
- Full Radio Noise process
- Performance assessment of RADAR sensors and mm-wave devices
- Antenna and sensors placement

THE NEW CHALLENGE
Cars of the future will be smart and connected, forming a new driving experience, by combining security, comfort and infotainment with global and safe mobility. With sophisticated sensors, hundreds of processors, kilometers of wiring, and onboard electronics reaching up to 40% of the total manufacturing cost, mastering the overall electromagnetic compliance of a fully equipped automotive vehicle has become a key challenge for EMC experts. Shortened development cycles combined with less prototypes make ESI Virtual Prototyping the right solution for a safe and reliable electromagnetic design.

A COMPLETE AND DEDICATED ENVIRONMENT
Within the Visual-CEM environment, fully equipped industrial models can be managed in a complete and dedicated manner. All major frequency and time domain computational techniques are proposed by CEM Solutions for both radiated and conducted phenomena. Method of Moments with Multi-Level Fast Multipole Method (MoM/MLFMM), Multiconductor Transmission Lines (MTL), Physical Optics (PO), Finite Element (FEM) or Finite Difference (FDTD) can be applied by either stand-alone use, coupled, or a hybrid of two, to address key electromagnetic issues early in the development stage of new vehicles:
- Immunity, radiation and overall EMC compliance,
- Monitoring sensors, antenna placement and optimization,
- Radio Noise and other interference issues with internal cabling,
- Performance assessment of RADAR sensors and millimeter-wave devices (short and long range, 24 or 77 GHz).

STAGE 1
CRIPTE computation (internal cabling)

STAGE 2A
EMR coupling process (from internal cabling)

STAGE 2B
EMS coupling process (towards antenna)

STAGE 3
EfieldFD MoM computation (windshield antenna)

 Courtesy: Verizon Telematics
SELECTED AUTOMOTIVE APPLICATIONS
WITH CEM SOLUTIONS

Virtual Anechoic Chamber
With dedicated 3D/MTL coupling options, Virtual Testing facilities are proposed for EMC Compliance of fully equipped industrial models, reduced Electromagnetic Susceptibility (EMS) and low Emission (EMI).

Radio Noise and Electromagnetic Interference
Starting with the 3D/MTL coupling configurations aimed at addressing most EMC compliance scenarios, a dedicated Radio Noise process has been defined to evaluate the unwanted electromagnetic noise created by internal cabling and other emitting components towards onboard components, e.g. back window antennas or Bluetooth receivers.

Advanced Driver Assistance & Blind Spot Detection
With the objective of defining a design leading to optimized electromagnetic performances, 24 GHz RADAR sensors were investigated behind various 3D shaped plastic bumpers covered with very thin metalized paint coatings. A highly multiscale modeling process was developed, combining standard computational techniques (FDTD, PO) with analytical formulations to include the roadway, metallic rail guards and other nearby vehicles in the complete 3D scene. Within this frame, dealing with a fully realistic scenario gathering all major contributors was the key challenge for a 24 GHz operating frequency.

Active Safety & Long Range Detection Devices (Anti-Collision)
By tripling the operating frequency, the multiscale coupling strategy applied with Blind Spot assistance can be extended to Long range detection. Combining Physical Optics with Fd Td or MoM/MLFMM, two options are proposed based either on Huygens surfaces surrounding the transmitter or using the Spherical Wave Expansion (SWE) technique, this second method being much faster and easier to handle.

ABOUT ESI GROUP
ESI is a pioneer and world-leading provider in Virtual Prototyping that takes into account the physics of materials. ESI boasts a unique know-how in Virtual Product Engineering, based on an integrated suite of coherent, industry-oriented applications. Addressing manufacturing industries, Virtual Product Engineering aims to replace physical prototypes by realistically simulating a product’s behavior during testing, to fine-tune fabrication and assembly processes in accordance with desired product performance, and to evaluate the impact on product use under normal or accidental conditions. ESI’s solutions fit into a single collaborative and open environment for End-to-End Virtual Prototyping. These solutions are delivered using the latest technologies, including immersive Virtual Reality, to bring products to life in 3D; helping customers make the right decisions throughout product development. The company employs about 1000 high-level specialists worldwide covering more than 40 countries. ESI Group is a French company listed in compartment C of NYSE Euronext Paris.