AICRAFT FUEL TANK DESIGN AGAINST HYDRAULIC RAM : AN OPTIMISATION EXERCISE

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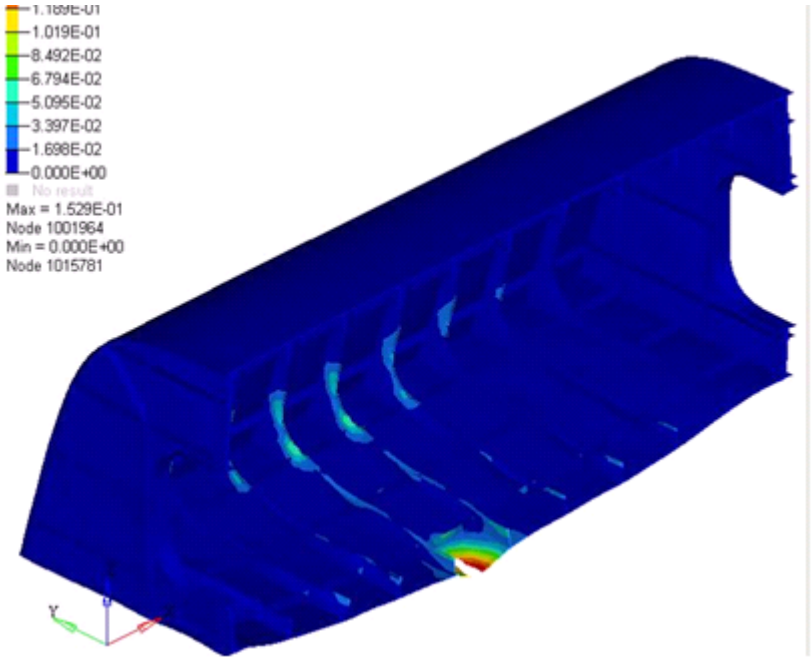
Reducing vulnerability of military aircraft can be achieved through configuration, damage tolerance and damage resistance. Damage resistance is mostly a question of materials and structural design. Because of the performance requirements in modern applications the use of lightweight composite materials, e.g. Glass or Carbon Fibre Reinforced Plastic, is recommended. Fuel tanks, when hit, may display a special failure mode called "Hydrodynamic Ram" (HRAM), in which the penetrating projectile transfers its energy and momentum to the fluid and thus creates shock and pressure waves, which can rupture the entire tank structure. The construction of composite tanks with a reduced vulnerability – meaning here acceptable rupture level - wrt HRAM turns then to become a very difficult optimisation problem. In the BaTolUS project, ONERA performed a methodological study to try a general optimization exercise thanks to the commercial HyperStudy software. Radioss is the Finite Element (FE) fast-dynamics (or “crash”) code that is used to solve the HRAM response of a generic metallic fuel tank structure. The formulation of the “vulnerability” minimization problem, constraint(s) and objective function(s) phylosophy are briefly introduced in the presentation. Numerical results are presented to illustrate that optimization studies can be made with commercial tools according to the proposed methodology, that can be efficient in industrial terms (CPU times) and can actually produce general design recommendations.



Plastic strain in metallic generic fuel tank structure under HRAM loads