NDSU Engineering Grand Challenge Projects

Finite Element Method in Analysis and Engineering Design

The finite element method (FEM) is a powerful numerical technique and tool for engineering analysis and design. It has applications in all areas of engineering particularly in solid, fluid, as well as structural mechanics. The basic concept in the physical interpretation of the FEM is the subdivision of the mathematical model into disjoint (non-overlapping) components of simple geometry called finite elements or elements. The response of each element is expressed in terms of a finite number of degrees of freedom characterized as the value of functions, at a set of nodal points. Following are some simple areas that FEM can be applied.

-- Structure analysis, a bridge, an oil platform…

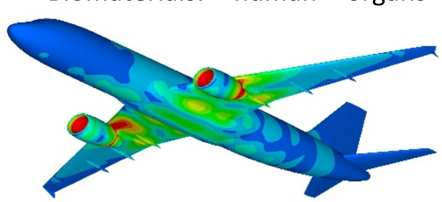
-- Solid mechanics: gears, an automotive powertrain …

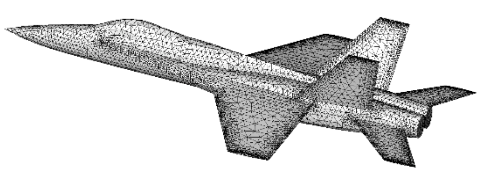
-- Dynamics: vibration of Sears Tower, earthquake…

-- Thermal analysis: heat radiation of finned surface, thermal analysis of a power plant…

-- Electrical analysis: piezo actuator, electrical signal propagation…

-- Biomaterials: human organs and tissues…



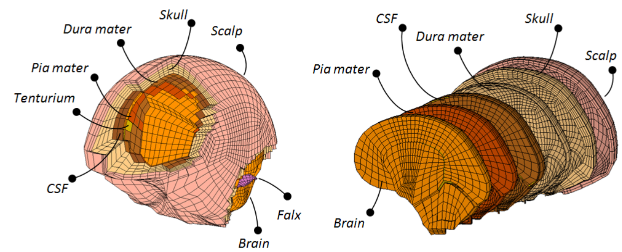


GC Mentor

Dr. Ghodrat Karami

Professor
Mechanical Engineering department
Phone 701-231 5859
Email: g.karami@ndsu.edu

http://www.ndsu.edu/me/faculty/karami.php



Multiscale Biomechanics Analysis of Brain

Tissue analysis and design is a new subject in engineering. In recent years at the NDSU mechanical engineering we have developed methods to model the human head with all its components. In particular the brain has been modelled under impact, and shock loadings to examine the extent of brain injury. In reality still we have a long way to go to model and precisely understand the brain and its responses. In particular defining the material properties of the human head components is a real challenge in biomechanics research. Researchers have used various constitutive relations ranging from simply linear elastic to complex non-linear hyper-visco-elastic. Multiscale analysis can provide a better understanding and modeling of the brain tissue.