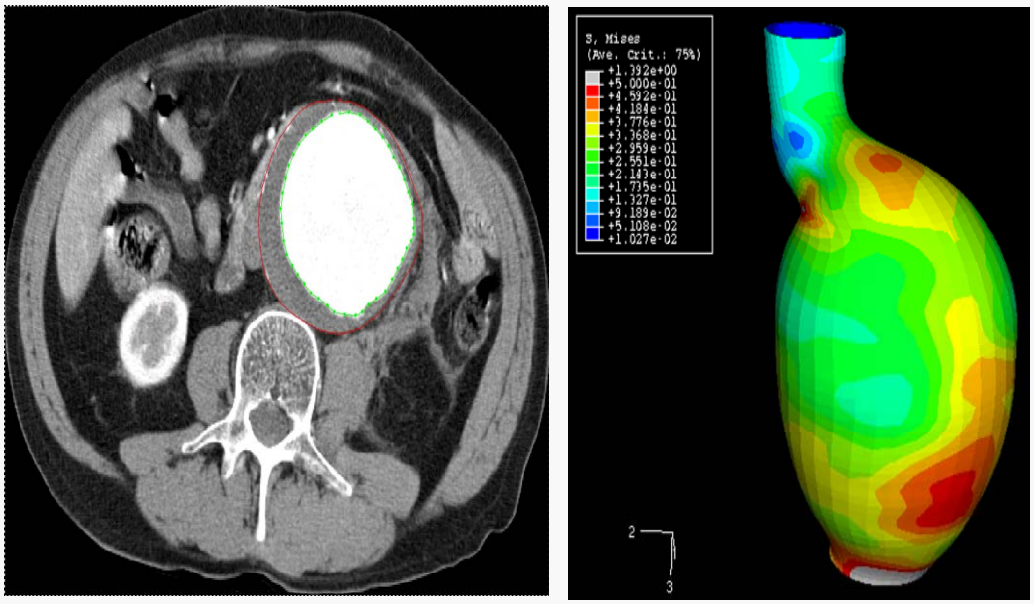
Scientific Computing Within the ORNL Modeling & Simulation Group: Biomedical Simulation

The ORNL Modeling and Simulation Group (MSG) develops sophisticated numerical solutions for a wide range of scientific, engineering, and operational applications. MSG's core competency is computational physics and engineering, and within this focus area we have leveraged our scientific computing expertise to develop a significant biomedical simulation capability. Our problem solving scope includes the following.

- Physics-based engineering simulations of (a) organ systems such as airflow and species concentration in pig lungs, (b) aortic aneurysm rupture and endoleak, and (c) transendothelial cellular motility. Geometry models used in such analyses can be generated directly from Visual Human databases and/or patient-specific imaging data such as CT scans.
- Web-based modeling environments for physiological systems such as (a) pharmacokinetic analyses of xenobiotic (e.g., mercury and nicotine) uptake in human organ systems and (b) radiation transport in humans to optimize beam placement and dose.
- Diagnosis and event forewarning using non-linear analysis of chaotic time-serial physiological data such as scalp EEG readings and acoustic lung sounds.
- Advanced web-based visualization environment for DARPA's Virtual Soldier and Virtual Autopsy Projects.
- Founding member of the Joint ORNL/UT Center for Musculoskeletal Research.

These applied scientific computing capabilities represent an extremely versatile modeling and simulation resource for a broad range of R&D, industrial, homeland defense, and military applications. We welcome the opportunity to discuss your potential applications and ways MSG can contribute to a solution.



In collaboration with the UTMCK Department of Surgery, MSG utilized patient-specific CT scans to develop a 3D finite-element analysis model of an abdominal aortic aneurysm, and then used the resulting stress distributions to identify the ultimate rupture site

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