

Computational Musculoskeletal Modeling

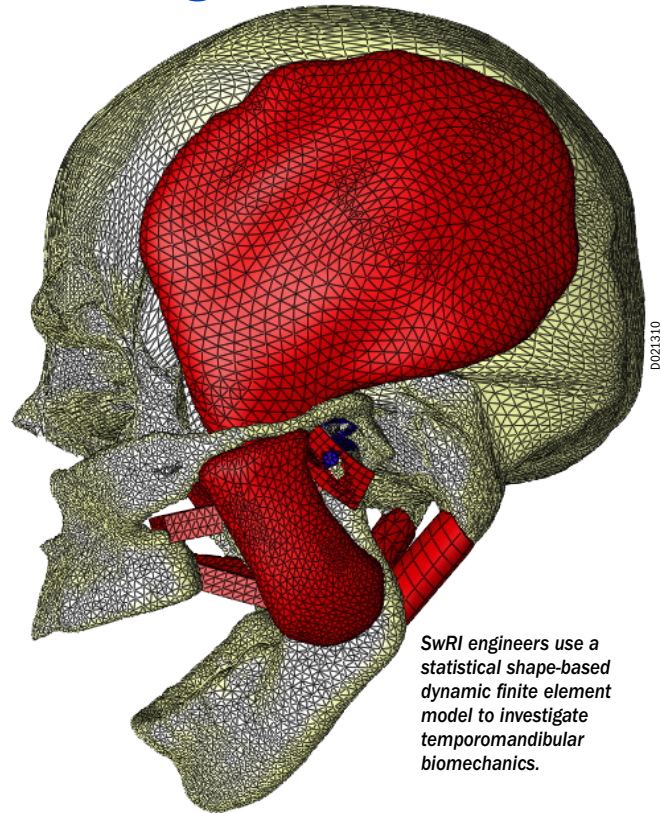
Southwest Research Institute® (SwRI®) offers expertise in advanced computational modeling to understand the mechanics of complex musculoskeletal conditions. Engineers in the Musculoskeletal Biomechanics Section have more than 35 years of experience in developing and applying advanced computational and experimental methods, including:

- Statistical shape modeling-based finite element analysis
- Advanced computational constitutive model development
- Risk of musculoskeletal disease initiation and progression
- Musculoskeletal injury risk prediction
- Clinical bone fracture risk assessment

Probabilistic Mechanics and Reliability Methods

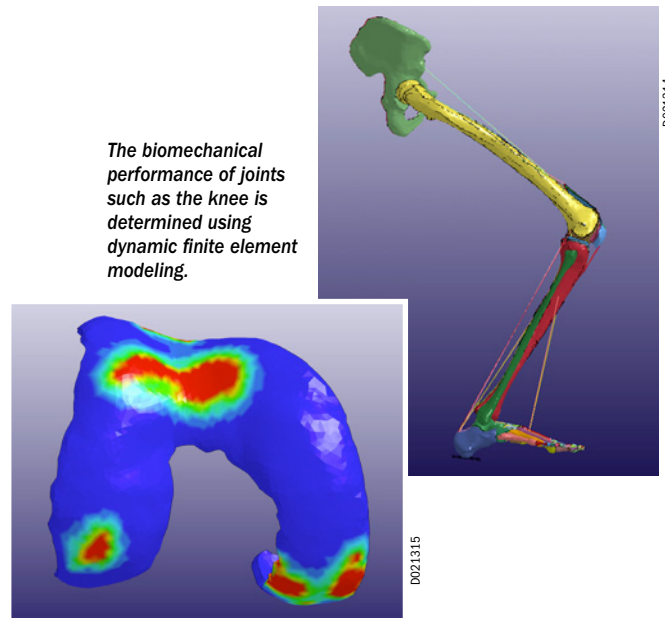
SwRI's musculoskeletal biomechanics engineers use advanced probabilistic mechanics and reliability methods to address how the inherent variability and uncertainty associated with human biological systems affect predictions of system performance and functionality. These methods include:

- Imaging-based methods of defining subject-specific or specimen-specific finite element models
- Parametric and probabilistic finite element modeling methods to investigate the effect of variation and/or uncertainty in model input parameter definition (i.e., geometry, material properties, loading, and boundary conditions) on predicted outcome
- Experimental verification and validation methods at multiple-length scales ranging from ultra- and microstructural characterization to continuum-level biological material behavior to musculoskeletal performance at the whole-body level
- Implementation and development of statistical shape and density/trait modeling methods that allow sophisticated analyses of variation within a population
- Description of variability in bone shape and traits in both cross-sectional and longitudinal studies



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SwRI engineers use a statistical shape-based dynamic finite element model to investigate temporomandibular biomechanics.



The biomechanical performance of joints such as the knee is determined using dynamic finite element modeling.

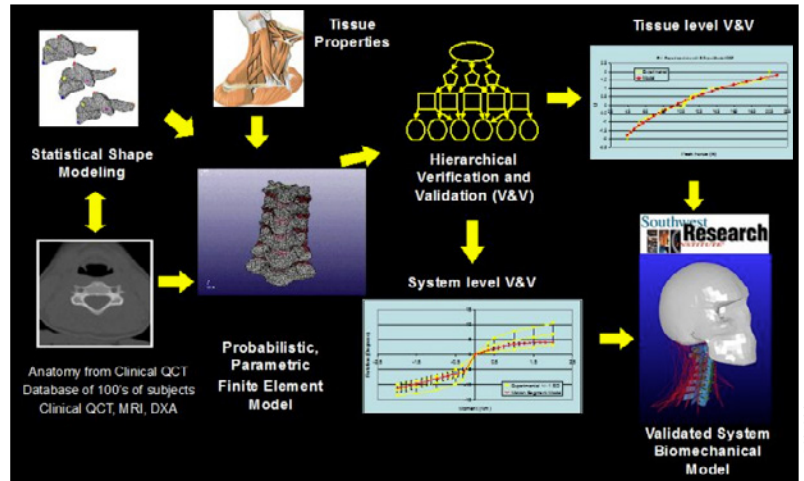
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Applications

SwRI's biomechanics engineers develop and apply advanced computational and unique experimental techniques to address a variety of musculoskeletal biomechanics-related problems, including:

- Osteoporosis
- Osteoarthritis
- Bone fracture risk
- Musculoskeletal injury risk
- Musculoskeletal implant failure risk



SwRI engineers use advanced probabilistic mechanics and reliability methods to address how the inherent variability and uncertainty associated with biological systems affect predictions of biomechanical performance and functionality. In one application, the probability of injury to the cervical spine (neck) of naval aviators caused by high acceleration maneuvers is being investigated.

We welcome your inquiries.
For additional information, please contact:

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Southwest Research Institute is an independent, nonprofit, applied engineering and physical sciences research and development organization using multidisciplinary approaches to problem solving. The Institute occupies 1,200 acres in San Antonio, Texas, and provides more than 2 million square feet of laboratories, test facilities, workshops, and offices for nearly 3,000 employees who perform contract work for industry and government clients.

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