



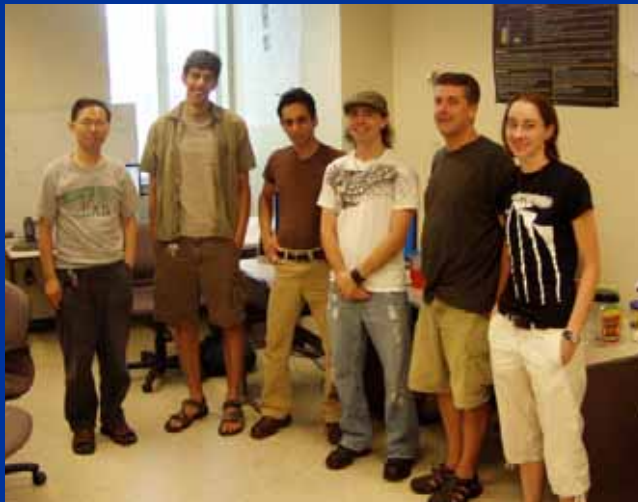
Trent M. Guess, PhD

Associate Professor of Mechanical Engineering

University of Missouri-Kansas City, Kansas City, MO

guesstr@umkc.edu

<http://www1.sce.umkc.edu/~guesstr/MBRL.htm>



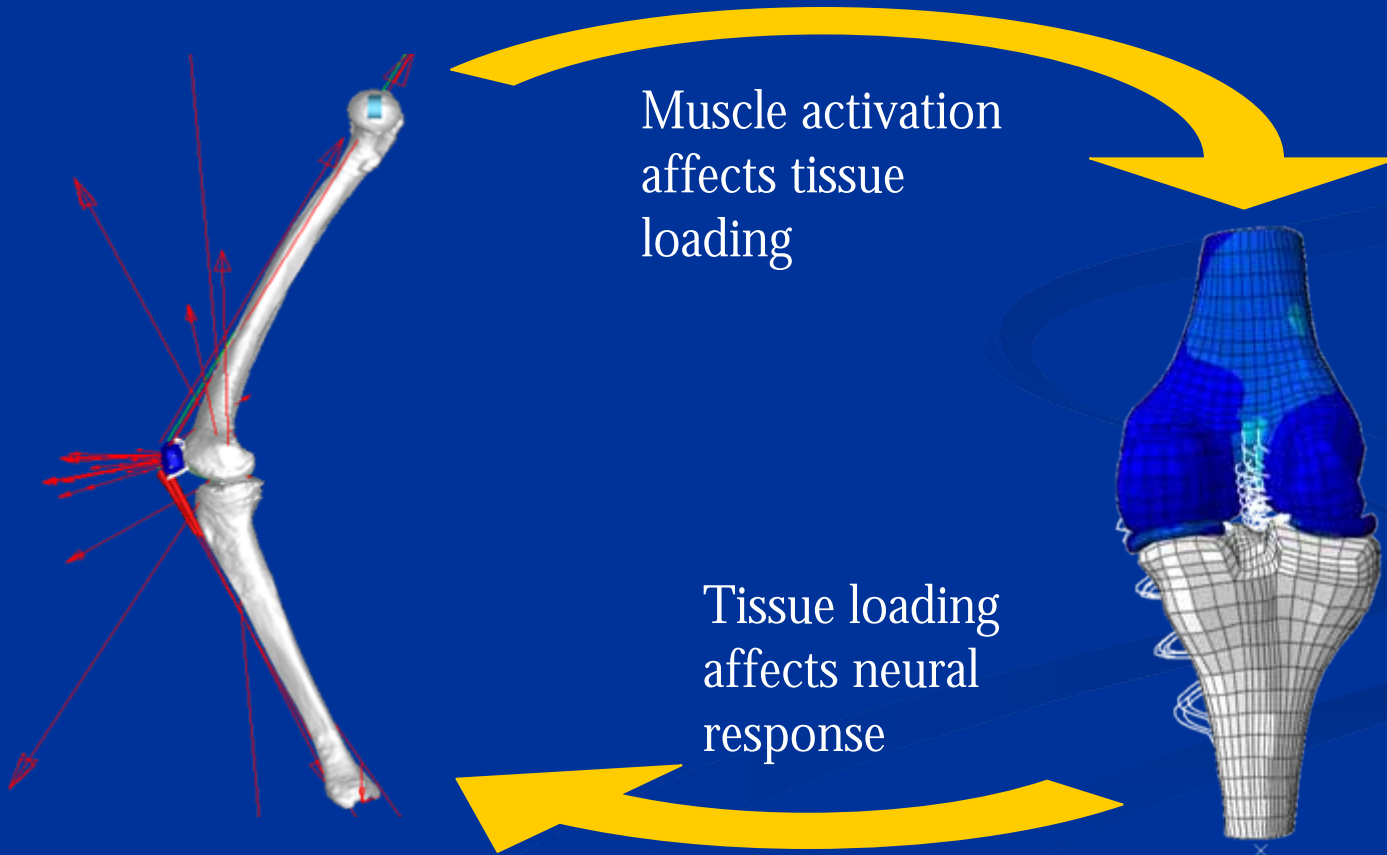
Musculoskeletal Biomechanics Research Lab



UMKC Human Powered Vehicle Team

Musculoskeletal Interdependency

- In many scenarios, the interdependency of muscle force and tissue response justifies a **concurrent** multi-scale/multi-domain modeling approach

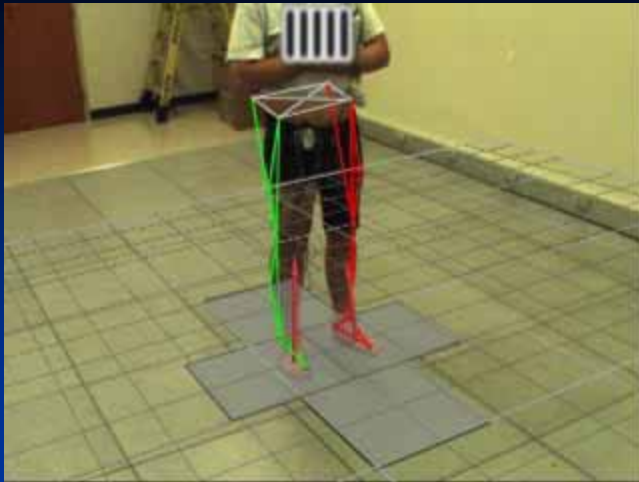


Musculoskeletal Interdependency (concurrent simulation)

- **Goal:** develop computationally efficient, functionally analogous, musculoskeletal joint models within forward dynamics movement simulations
 - interdependency of muscle force and tissue response
 - more realistic loading applied to organ and tissue level models
 - more realistic muscle activation patterns

Musculoskeletal Biomechanics

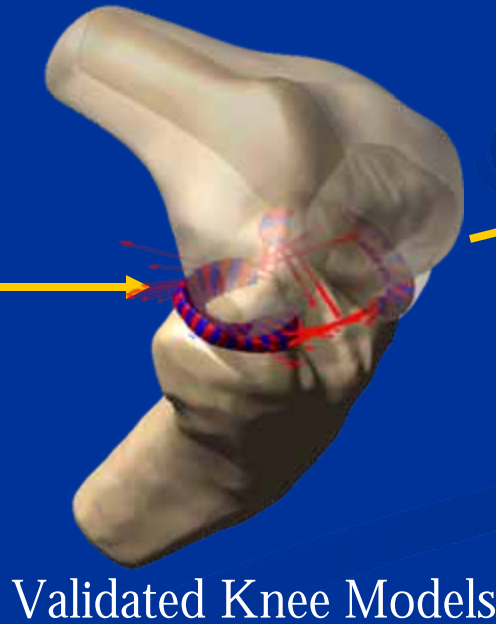
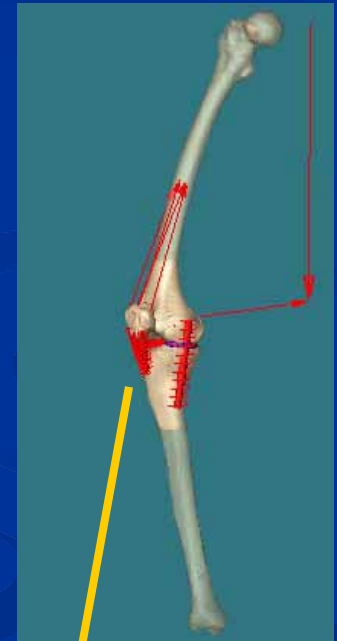
Predicting Knee Loading



UMKC Human Motion Lab

Motion, Ground Reaction Forces, EMG

Neuromusculoskeletal Model



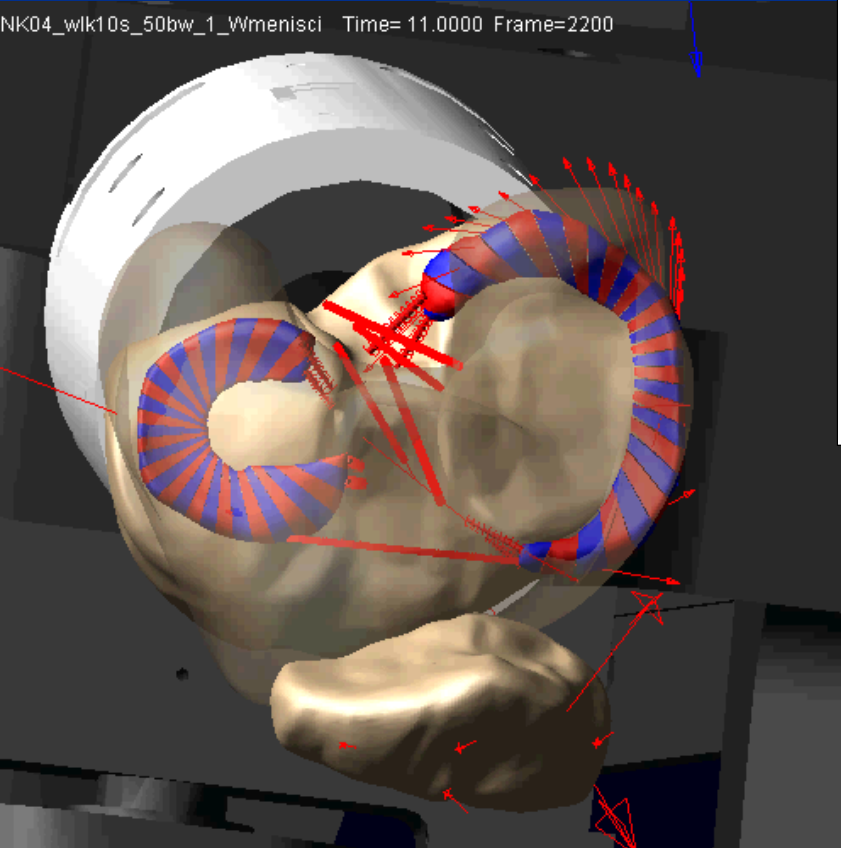
Validated Knee Models

Loading on ACL, cartilage, menisci.....

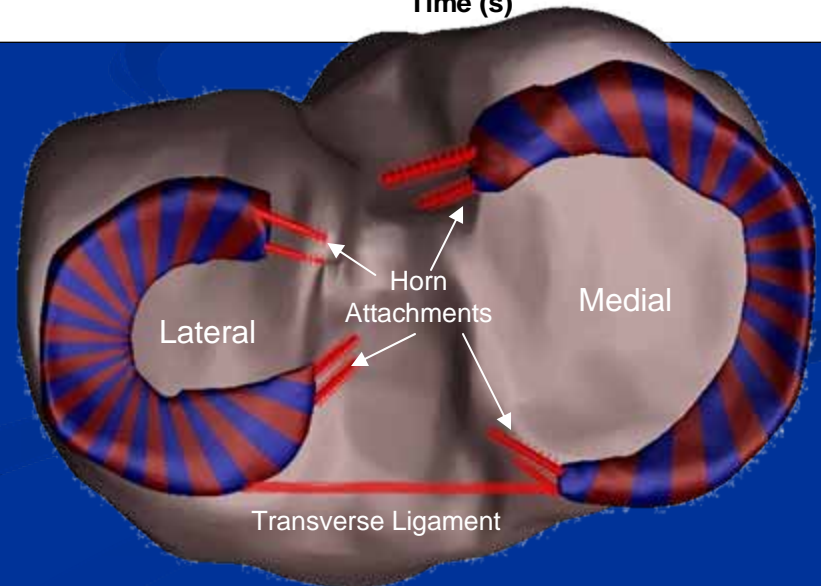
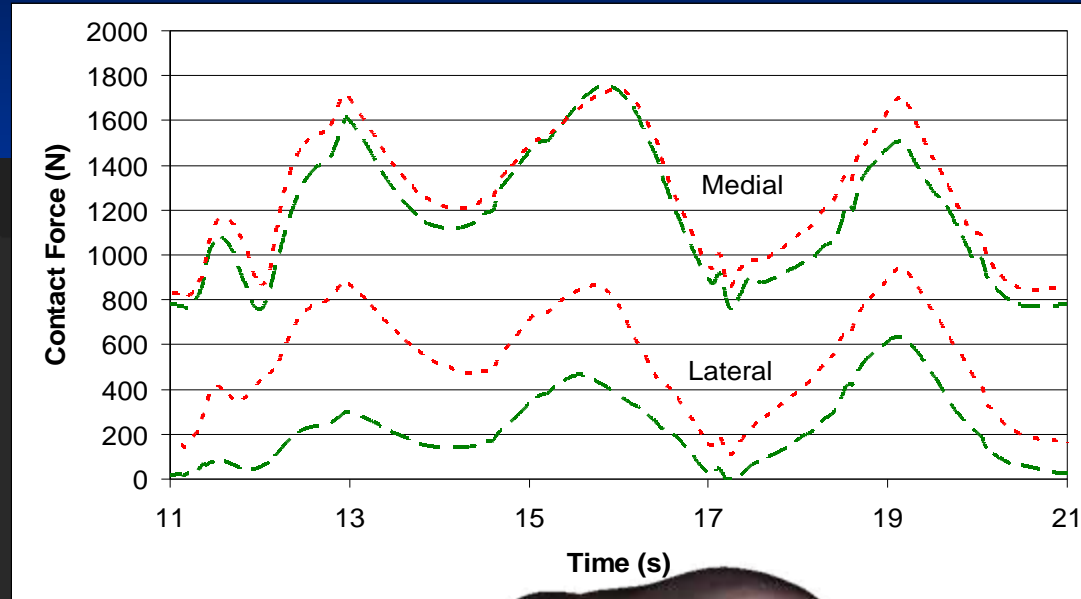


Multi-body menisci Model Simulated Walking right knee

NK04_wlk10s_50bw_1_Wmenisci Time= 11.0000 Frame=2200



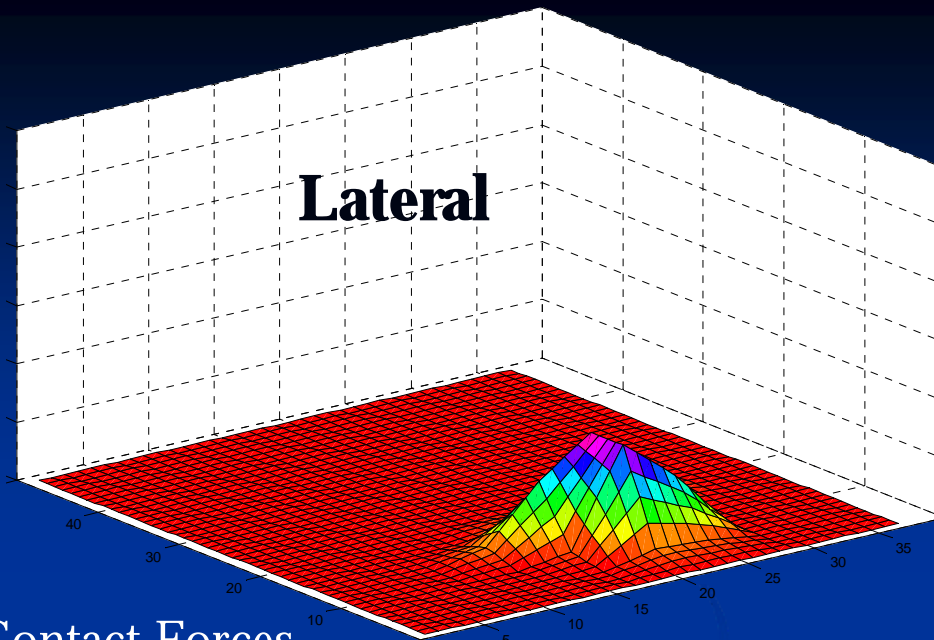
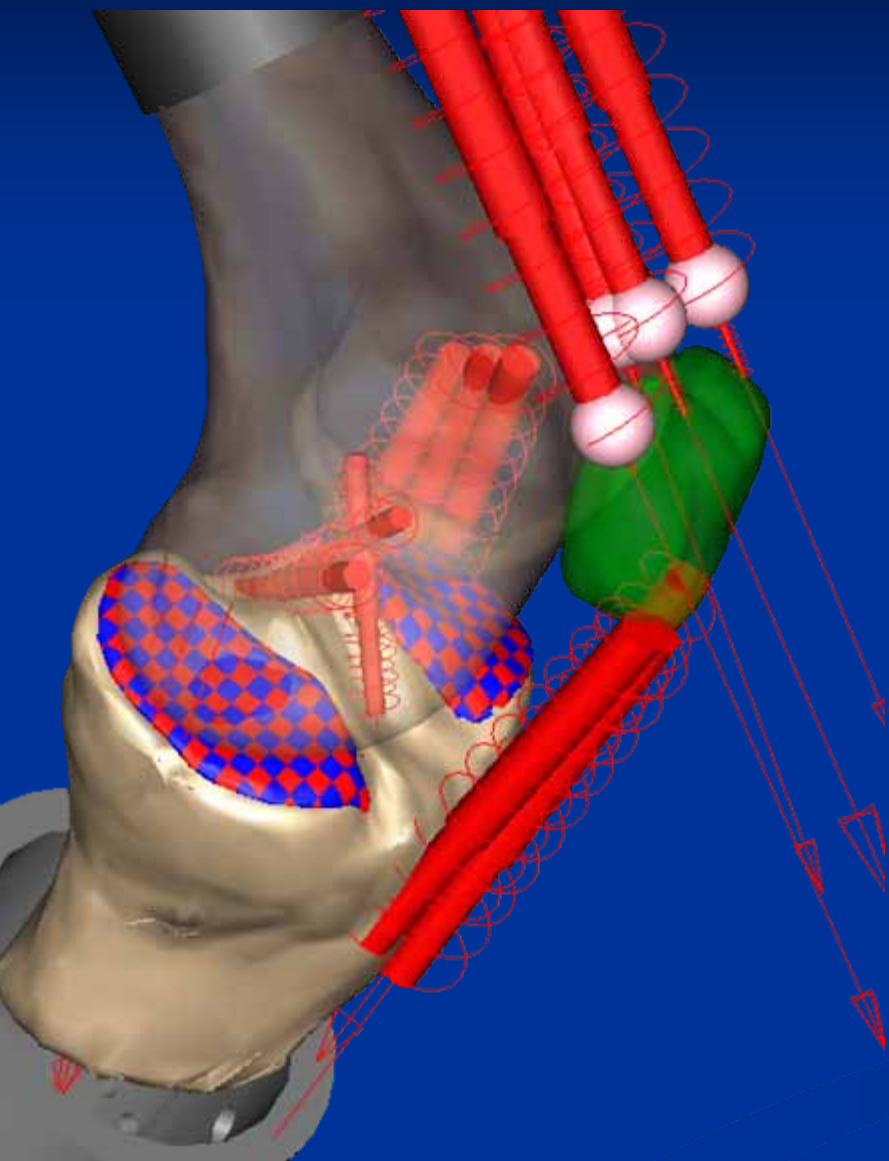
Cartilage contact force at the knee with --- and without - - - - - inclusion of the menisci.



Looking through the femur onto the tibial plateau.

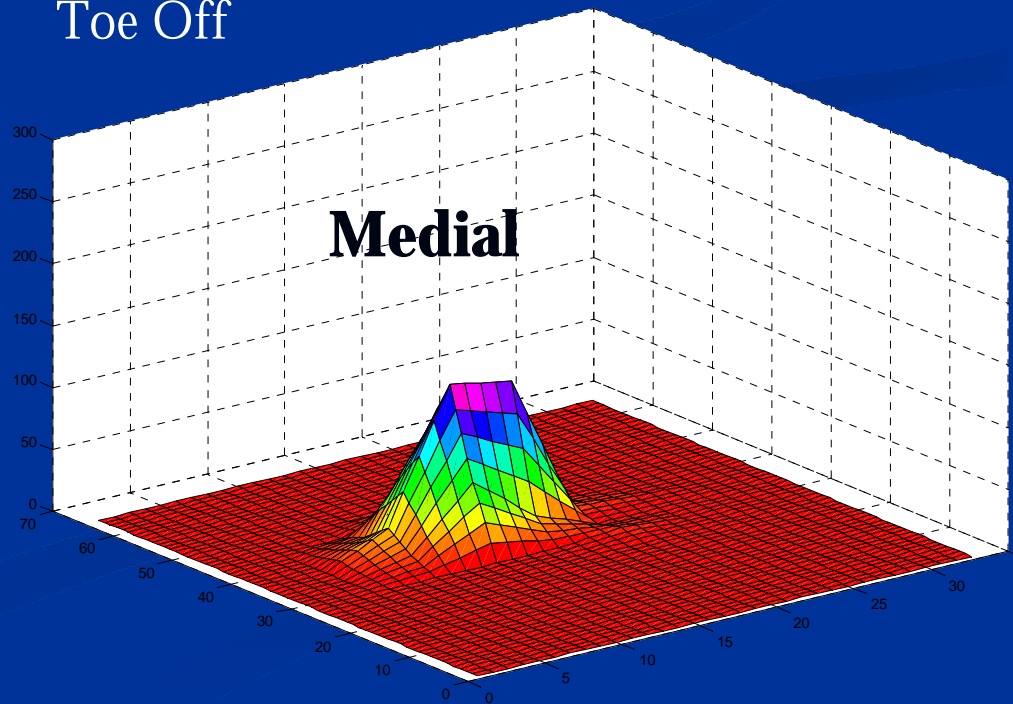
Multi-body cartilage model

Simulated Walking



Contact Forces

Toe Off



■ Dynamic Simulation of Joints Using Multiscale Modeling

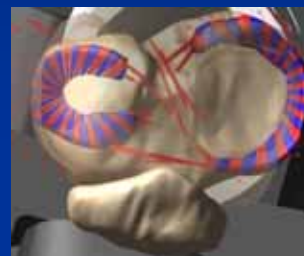
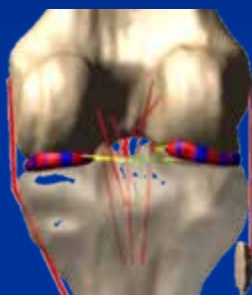
■ National Science Foundation

■ Award # CMS-0506297 under the IMAG program for Multiscale Modeling

■ PI Trent M. Guess

Ligaments

Katie Weimer,
Paul Wilson

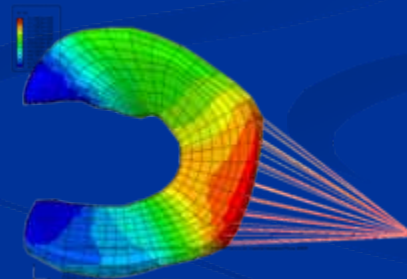
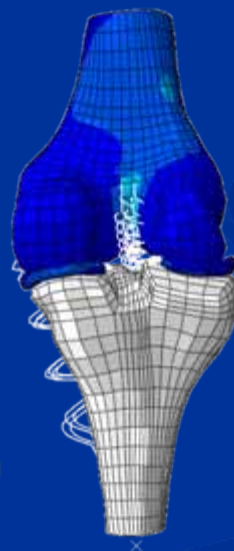
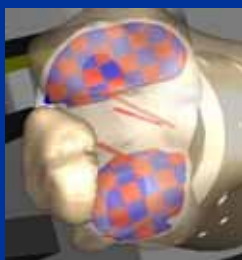


Meniscus

Mohammad Kia,
Meenakshi Mishra,
Dr. Ganesh
Thiagarajan

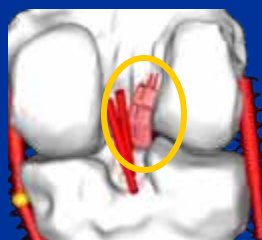
Cartilage

Dr. Hongzeng
Liu



ACL

Katherine
Bloemker



Tibio-femoral Neural Network

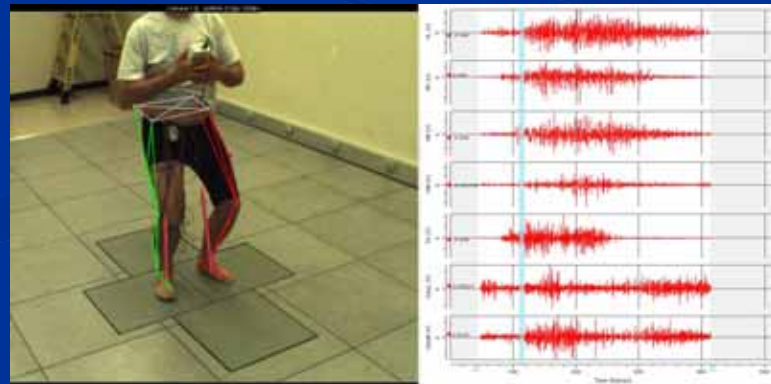
Gavin Paiva, Meenakshi
Mishra, Dr. Reza
Derahkhashani

■ MRI: Acquisition of an Experimental Platform to Support Research and Educational Activities in Human Motion

- National Science Foundation Award Number CBET-0821459
- PI Trent M. Guess



Left to right: Co-PIs Dr. Walter D. Leon-Salas, Dr. Gregory W. King, Dr. Reza Derakhshani, and PI Dr. Trent M. Guess.



■ Computational Simulation of Canine Biomechanically Induced Unicompartmental Osteoarthritis: a Concurrent Multiscale Approach

- Missouri Life Sciences Research Board Award # 09-1078
- PI Trent M. Guess
 - A Collaboration with the University of Missouri – Columbia (Dr. James Cook)

