



# BRG.L i f e M O D 2005<sup>®</sup>

## Biomechanics Modeling Package

“Exploring the performance of the biomechanical machine with physics-based simulation”

### OVERVIEW

The LifeMOD Biomechanics Modeler is the most advanced and complete human modeling program available today. Explore the possibilities of creating true physics-based biomechanics models for any living system. LifeMOD is a plug in to the popular **ADAMS software** (MSCsoftware, Inc.) to provide a complete modeling environment to refine the task of creating passive, and forward-dynamics biological models which interact with the environment, tools, equipment and each other! This technology empowers the investigator to thoroughly understand the forces and the nature of the control strategies behind biological activities.

The LifeMOD modeling environment is an accumulation of tools, databases and techniques developed over the past 20 years of performing commercial biomechanics simulation work for the world's top:

- Sports equipment manufacturers
- Orthopedic companies,
- Personal injury investigators,
- Universities and research institutions,
- Government agencies,
- Medical equipment manufacturers,
- Aerospace agencies.

### APPLICATIONS

Full dynamic models may be created for applications including:

- Vehicular injury simulation
- Slips, falls,
- Sports equipment
- Sports performance
- Rehabilitation
- Orthopedics
- Ergonomics
- Aerospace (astronaut)

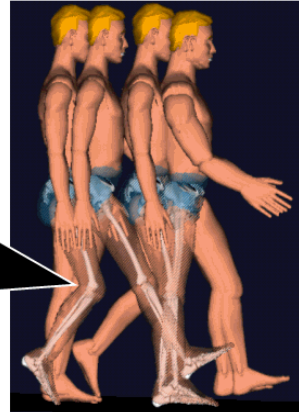
### BENEFITS

**Save time** by creating full body models in less than one minute!

**Increase innovation** by examining the functional effect of your product on the human model before it is made.



What are the forces and reactions?



**Test interaction** of the product or procedure with the human or a team of humans.

**Examine human reactions** to environmental loads, loads generated from a task or loads generated from the interaction with another human model.

**Model any biomechanics entity** using LifeMOD's powerful bone geometry import, generalized joint and muscle creation features.

**Universities** find LifeMOD most beneficial to provide students with a broad exposure to biomechanics as well as an excellent research tool.

### HIGHLIGHTS

#### General

**Fast model generation** - Complete human models may be constructed in less than one minute!

**Application specific model generation** - Models may range from simple (19 segment 18 joint) to quite complex, depending on the application for the correct balance of efficiency and accuracy.

**Multiple Interacting Models** - As many as 6 models may be created in

one environment. The models may interact with the environment, equipment, or each other to perform coordinated tasks. Models may be specified separately as passive or active.

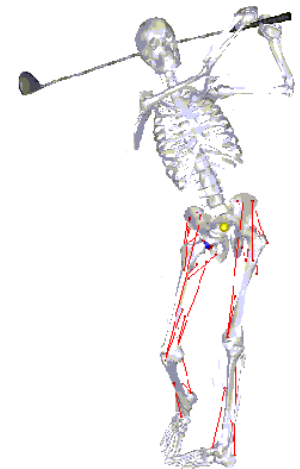
**Man-machine interaction** - Human models may be combined with other ADAMS models for full man-machine interaction studies.

**Interface to all motion capture systems** - LifeMOD provides a generic ASCII table format to interface to all motion capture devices.

**Passive and/or active human models** - Human models may be constructed as passive (response to the environment) or active (affecting the environment) or a combination of active and passive.

### Body Generation

**Multiple Interacting Models** - As many as 6 models may be created in one environment. The models may interact with the environment, equipment, or each other to perform coordinated tasks.



**Five Anthropometric Body Size Databases** - Databases included for GeBod data, and PeopleSize UK, USA, Japan and China databases.

**Several Types Human Body**



**Representation** - Five types of human body representation include male skin, female skin, ellipsoid, crash dummy and stick.

**Segments May Range in Bio-fidelity**

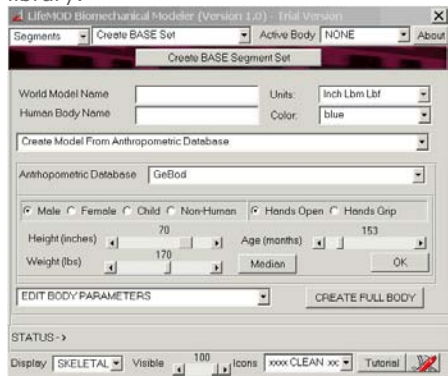
- LifeMOD employs a "segment refine" process to create human models. A 19 segment model is created initially, with bones lumped into segments. The segments are scaled based on the anthropometric databases. Individual segments may then be refined or dispersed into the true number of bones for detailed representation. This allows the investigator to create a model with the most efficient fidelity.

**Complete Scalable Skeleton** - All bone graphics representing the complete human skeleton are generated and scaled based on the anthropometric database which includes male/female adult and child populations.

**Any Biological Entity May Be Simulated**

- LifeMOD allows the import of body segment geometry from any biological organism.

**Large Body Posture Library** -Large standard library of postures as well as a posture save capability to add to the library.



**Human Joints**

**Human Joints Automatically Generated**- A standard set of 20 tri-axis joints is created automatically. Each joint DOF may be individually modified to include stops, forces, friction, torques, etc.



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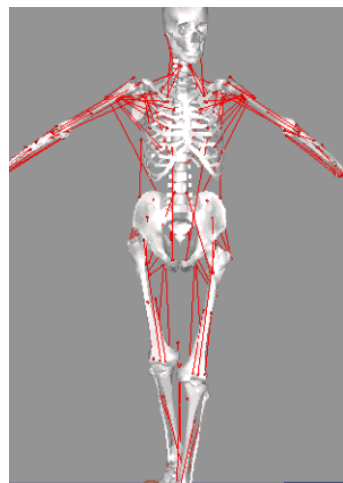
**Force-based joints** - More sophisticated joints which rely on bearing surface contact forces and ligament stabilization may be modeled

**Hybrid III Crash Dummy Strength Characteristics**

- Crash dummy strength characteristics are available for passive-type simulations. The strength model may be scaled to the particular body size and gender. The strength algorithm includes joint friction, non-linear stiffness/damping and limits with hysteresis using data derived from the physical dummy.

**Muscle Modeling**

**Full Body Muscle/tendons**-The joints may be stabilized using ligament forces and driven using muscle forces. LifeMOD contains a library of full body muscle geometry, attachment points and mechanical properties which scale based on the height, weight, gender and age of the individual. The muscles generate forces for a direct dynamics simulation of virtually any activity!



**Automatic PD-servo controllers created at each joint axis.**

- Using joint motion patterns developed from inverse-dynamics solution, pd-servo controllers may be created at each joint DOF to allow the human model to track the recorded motion using joint torques.

**Tissue contact force tools**-Tools are available to model the forces resulting from body segment contacting the environment, or each other.

**Body Motion**

**Any MOCAP device maybe used to provide data**-LifeMOD contains a standard interface to motion capture products through a simple marker trajectory ASCII text file.

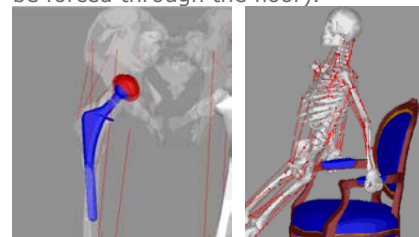
**Complete marker sets automatically positioned**-Marker sets are automatically created on the model after

import from the motion capture system. **Accommodates subject-model differences** and other error sources- Since motion agents are not rigidly attached to the model, they can allow some relative motion thus, accommodating any model-subject discrepancies and/or other data errors (i.e., skin wobble).

**Analysis**

**Inverse dynamics simulation**

- After the motion agents are positioned on the model, a simulation is performed to capture the motion of the model and/or muscles. The motion agents drive the model, yet the model is under the influence of the joint limits, external forces and gravity (i.e., the foot will not be forced through the floor).



**Forward dynamics simulation**

- The human model is driven using muscle contraction histories from an inverse-dynamics analysis. The model is guided by the internal forces (joint torques and/or muscle forces) and influenced by the external forces (gravity, contact, etc.)

**Results**

**Animations** -The simulation results may be used for detailed animations with dynamic plot display. Muscle force scaling force vectors are displayed during the animation. Also, move (avi) files may be created instantly.

**Kinematics**-Kinematic data including joint/segment displacements, velocities, and accelerations may be recorded in any coordinate frame. Any location of on the model may be tracked and reported. Kinematic data from any interfacing mechanical system may also be reported.

**Kinetics** -The model kinetics include torques and forces such as joint torques, soft tissue forces and contact forces. Internal reactions such as mechanical system forces and interface forces may also be reported.

