Mech 4652
Kinematics of Human Motion

Course Description

The science of biomechanics is based on mechanical models and biological experiments. Students will explore the application of classical mechanics to the analysis of human motion related to athletics, orthopaedics, and rehabilitation. Emphasis is also placed on numerous experimental facts collected from the biomechanical research literature. Topics include kinematic geometry of a single body, the description of joint configuration, and differential kinematics of bio-kinematic chains. Three-dimensional kinematics of individual joints (i.e. the knee, hip and elbow) is emphasized from the perspective of total joint replacement design.

Lecture Times

Monday, Wednesday, and Friday at 11:35 to 12:25
Room D 414

Tutorial

Wednesday 3:30 – 5:30
These will be held in either Room D414, the computer lab B316, or the Gait Lab in room 2123 of the Dentistry building at Robie and University.

Course Evaluation

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Assignments	15
Laboratories	10
Midterm Exam	25
Project	20
Final Exam	30
Total	100

Text

The following text will be required (highly recommended) for the course:
Zatsiorsky, V. **Kinematics of Human Motion**, Human Kinetics,1998

Course Objectives

By the end of the course students should be able to:

1. Understand the anatomical and mechanical analysis of human movement.
2. Appreciate the complexity of living species with regard to the motion they produce.
3. Evaluate the design of total joint replacements with respect to their kinematics.
4. Perform an analysis of three dimensional, six degree of freedom rigid body motion, expressing the results in terms of Euler angles, homogeneous matrices, or helical axis parameters.
5. Apply techniques from the field of robotics to describe and quantify the positions, velocities, and accelerations of limb segments in terms of a kinematic chain.
6. Quantify the motion of articulating joints in terms of the centres and axes of rotation, and the behaviour of the contact kinematics (i.e. rolling, sliding).

September, 2003

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Week	Date	Topics	Section	Pages
1	Sept 5	**Introduction** Motivation for course		
2	Sept. 8	**Body Orientation** Definitions, Anatomical frames Independent coordinates of a rigid body The "Where is it?" problem	1.1 - 1.2.5	1-34
3	Sept. 15	**Body Displacement** Orthogonal transformations The "Alias and Alibi" problems	1.2.5	35-42
4	Sept. 22	**Describing Body Orientation and Displacement** Euler Method Helical Method	1.2.5	43-62
5	Sept. 29	**Application: Description of Human Eye Movement** Eye Orientation Listings Law, Donder's Law No Class on Friday Oct. 3	1.3	63-72
6	Oct. 6	**Body Posture** Joint Configuration	2.1	79-102
7	Oct. 13	**Thanksgiving** **Kinematic Chains** Robotics and biomechanics	2.2	103-131
8	Oct. 20	**Differential Kinematics of Human Motion** Velocity and acceleration of biokinematic chains Planar two-link chain to 3D movement of multilink chains	3.1	147-
9	Oct. 27	**MIDTERM EXAM** **Joint Geometry and Joint Kinematics 1** Intrajoint kinematics	4.1	227-250
10	Nov. 3	**Joint Geometry and Joint Kinematics 2** Centres and axes of rotation	4.2	251-271
11	Nov. 10	**Kinematics of Human Joints** Nominal joint axes	5.1	284-290
12	Nov. 17	**The Knee**	5.4	301-305
13	Nov. 24	**Case Study: Total Knee Replacement Design**		