devE150 Basic Modeling and Simulation Tools for Industrial Research Applications
https://classes.berkeley.edu/content/2021-fall-engin-150-001-lec-001

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Syllabus

COURSE OBJECTIVES: Comprised of an introduction to essential mathematical modeling and simulation tools, high-performance computing, digital-twin technologies and machine-learning. Afterwards, 8-10 industry-motivated projects are studied.

DESIRED COURSE OUTCOMES: Coverage of the modeling and simulation of modern engineering systems and their synthesis. *The goal of this course is to provide students with the general multipurpose tools needed for successful industrial research.* The course will help students develop intuition about modeling physical systems and strengths and weaknesses of a variety of numerical methods. Instructor's class notes will be used. Some commonly recurring mathematical tools needed are

- Modeling of complex physical systems,
- Simulation of complex physical systems,
- Machine learning algorithms for system optimization and
- High-performance computing methods for differential equations.

COURSE DESCRIPTION: The course emphasizes elementary modeling, numerical methods and their implementation on physical problems motivated by real-world phenomena that students are likely to encounter in their careers, involving dynamics, controls, structural analysis, materials engineering, robotics, manufacturing, heat-transfer, etc. The course will help students develop intuition about modeling physical systems and strengths and weaknesses of a variety of numerical methods, including discretization of differential equations and machine learning algorithms for optimization. There are several major applications, which have been selected because of their societal and industrial relevance: *(autonomous systems/drones, 3D imaging, aerial fire-fighting, explosions and protection, 3D printer systems, infectious diseases, pandemics and solar farms)*

TOPIC: **AN OVERVIEW OF THE FIELD OF SIMULATION AND DIGITAL-TWIN TECHNOLOGIES**

TOPIC: **MACHINE LEARNING AND OPTIMIZATION**

TOPIC: **MODELING AND SIMULATION OF AUTONOMOUS SYSTEMS-*SWARMS OF UAVS/DRONES***

TOPIC: **MODELING AND SIMULATION OF LIDAR/STEREOGRAPHIC 3D CAMERAS**

TOPIC: **MODELING AND SIMULATION OF AERIAL FIRE FIGHTING**

TOPIC: **MODELING AND SIMULATION OF EXPLOSIONS AND BALLISTIC SHIELDS/ARMOR**

TOPIC: **MODELING AND SIMULATION OF ADVANCED MANUFACTURING-*3D ROBOTIC PRINTERS***

TOPIC: **MODELING AND SIMULATION OF INFECTIOUS DISEASE CONTAMINATION**

TOPIC: **MODELING AND SIMULATION OF INFECTIOUS DISEASE DECONTAMINATION**

TOPIC: **MODELING AND SIMULATION OF INFECTIOUS DISEASE PROPAGATION/PANDEMICS**

TOPIC: **MODELING AND SIMULATION OF VACCINE DESIGN AND RESPONSE**

TOPIC: **MODELING AND SIMULATION OF OPTIMIZED VENTILATION SYSYEMS FOR DISEASE CONTROL**

TOPIC: **MODELING AND SIMULATION OF NEXT GENERATION SOLAR FARMS**

COURSE PREREQUISITES:

- **Basic programming, such as the UC Berkeley courses: E7 or CS 61A or Data 8+CS 88,**
- **Basic Physics, such as the UC Berkeley Course Physics 7a,**
- **Basic Math, such as the UC Berkeley Courses Math 53, Math 54**

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL: Free reader and notes provided.