

EME 171

Analysis, Simulation, and Design
of Mechatronic Systems

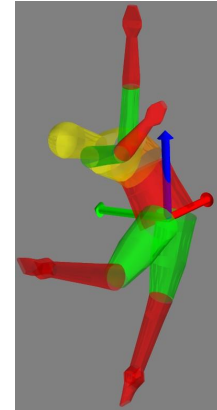
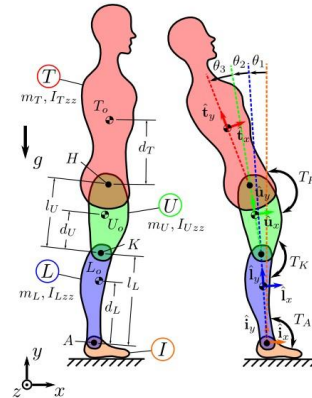
Fall 2019

Primary Instructor: Jason K. Moore

BS @ ODU 2004, Fulbright TU Delft 2009, MS/PhD @ UCD 2007/2012

Assistant Professor of Teaching since 2015 @ UC Davis

Teaches: dynamics, vibrations, biomechanics, mech. design, computer graphics, and capstone

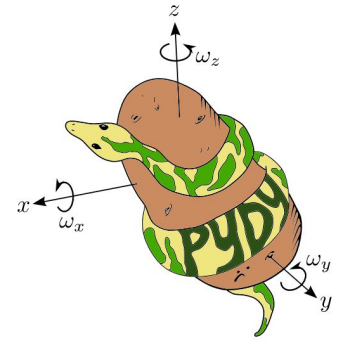
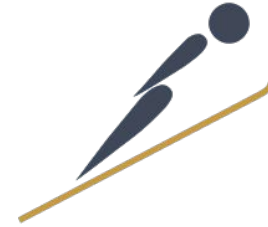


Projects



Laboratorium of Marvelous Mechanical Motum

<https://mechmotum.github.io/>



Teaching Assistant: Kevin Mallon



- PhD student working with Prof. Assadian
- BS/MS from Washington University in St. Louis
- Worked at robotic palette handling company
- Third time TA for EME 171
- Research: optimizing for battery life and fuel consumption in hybrid cars

What will you be able to do after this
class?

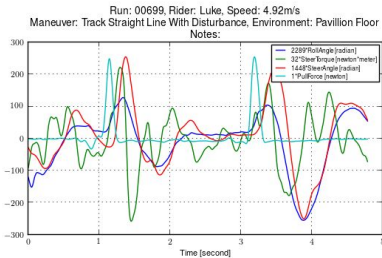
Modeling and Simulation of Dynamic Systems



Real World



Measurements



Measurements of real world

Abstraction

Domain Specific Schematics

Domain Neutral Schematic: Bond Graph

Mathematical Model

$$\frac{d}{dt} \begin{bmatrix} p_2 \\ q_5 \end{bmatrix} = \begin{bmatrix} -R_3/I_2 & -1/C_5 \\ 1/I_2 & -1/R_6C_5 \end{bmatrix} \begin{bmatrix} p_2 \\ q_5 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} e_1(t).$$

Computational Model

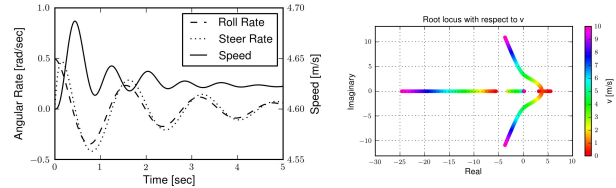
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% forces acting on a bicyclist
Fd = 1/2*rho*Cd*A*v^2; % drag force [N]
Fr = Cr*m*g*cos(alpha); % rolling resistant [N]
Fg = m*g*sin(alpha); % gravity force [N]

% evaluate the four 1st order explicit ordinary differential equations
thetadot = omega;
omegadot = (Kc*I - br*omega - Fd*R - Fr*R - Fg*R) / (J^2 + m*R^2);
idot = (Rb*I - Kc*omega - V)/L;
xdot = v*cos(alpha);

% pack the state derivatives in a vector
sdot = [thetadot; omegadot; idot; xdot];
                    
```

Analysis & Simulation



Prediction of real world

Validation

Example: Electric Bicycle/Motorcycle

