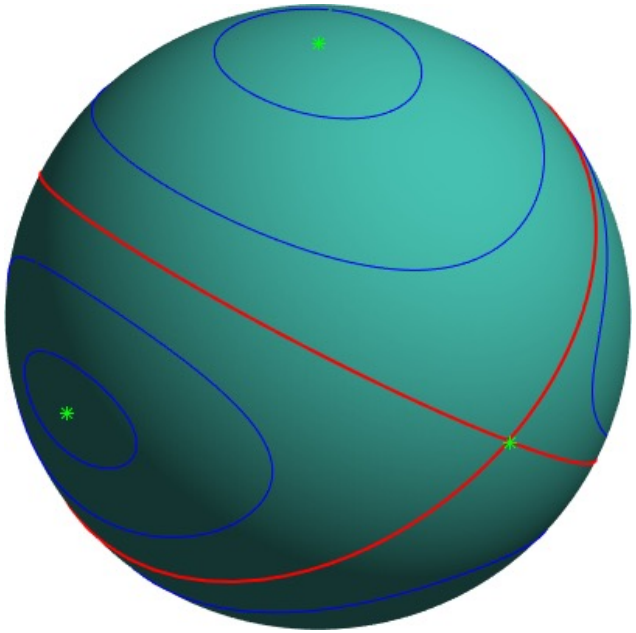
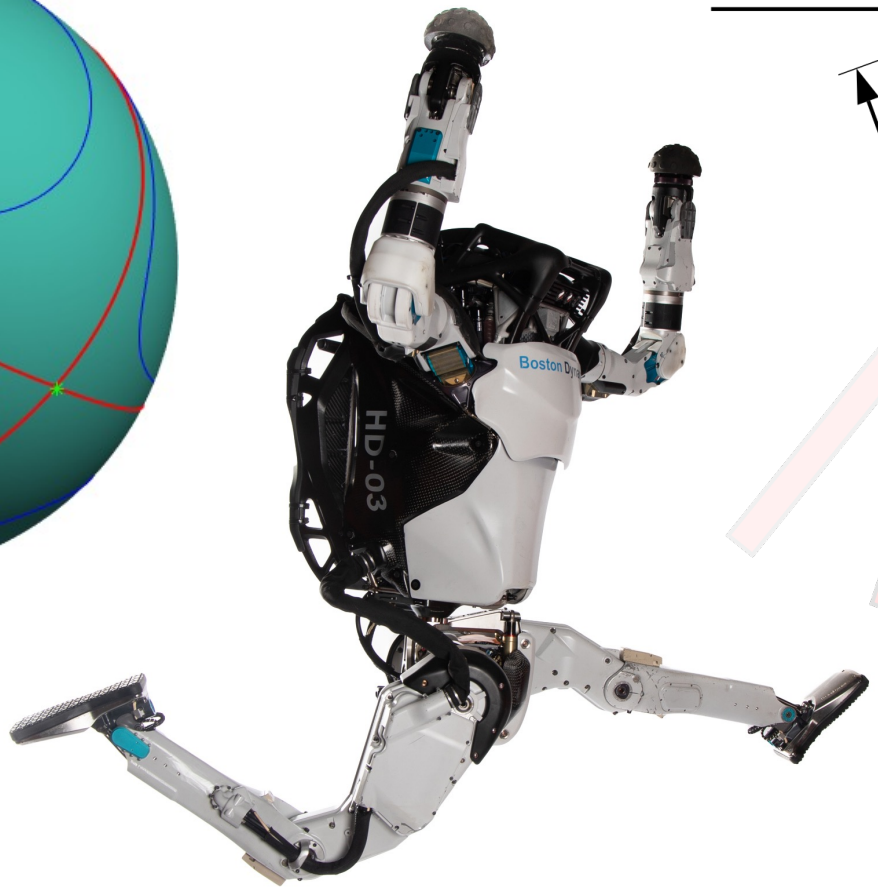
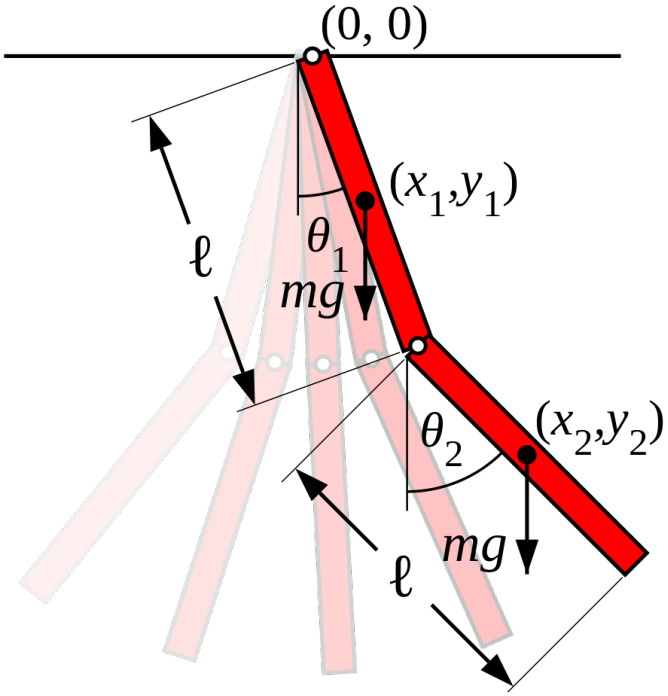
Advanced Robot Dynamics and Simulation

16-715







Fall 2021

Course Team

Zac Manchester
Assistant Professor
Instructor

Kevin Tracy
PhD Student
TA

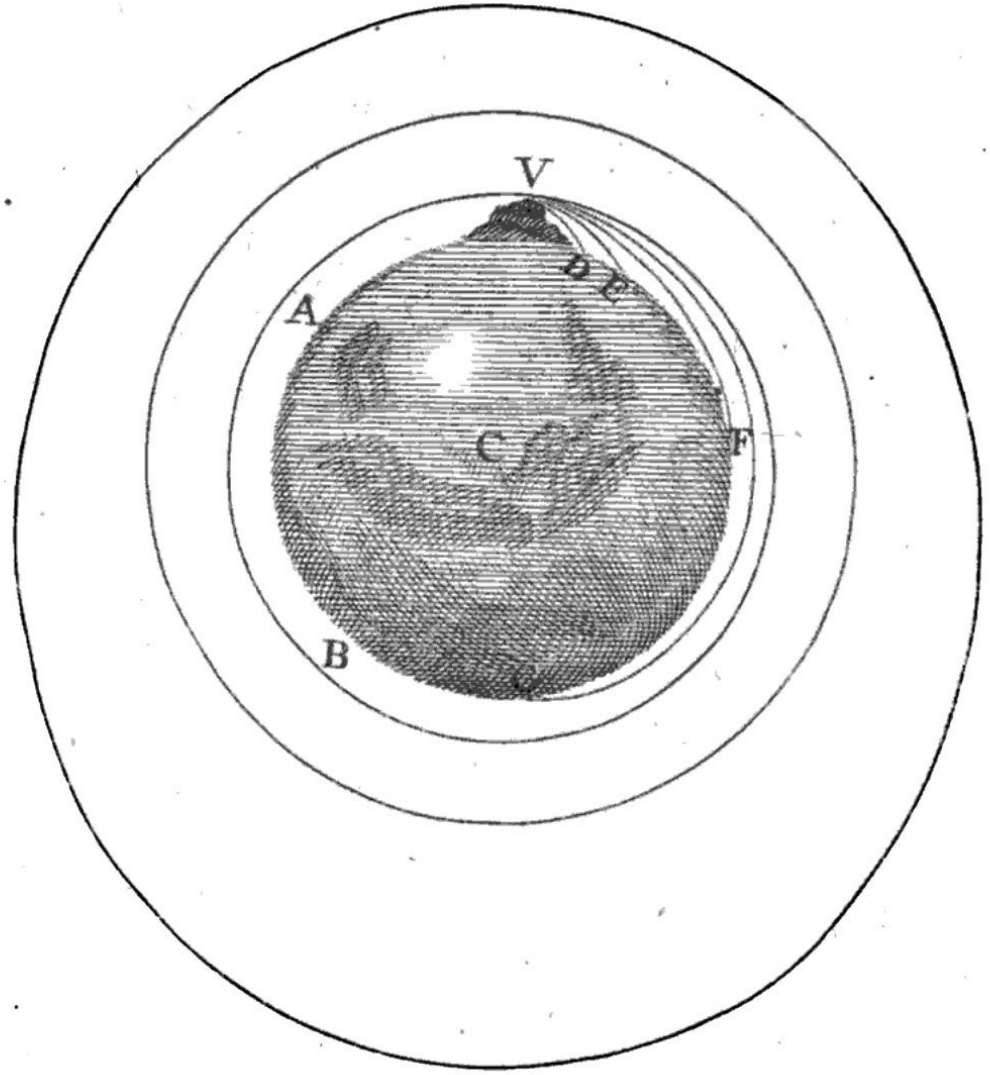
A Brief History of Dynamics

PHILOSOPHIÆ
NATURALIS
PRINCIPIA
MATHEMATICA.

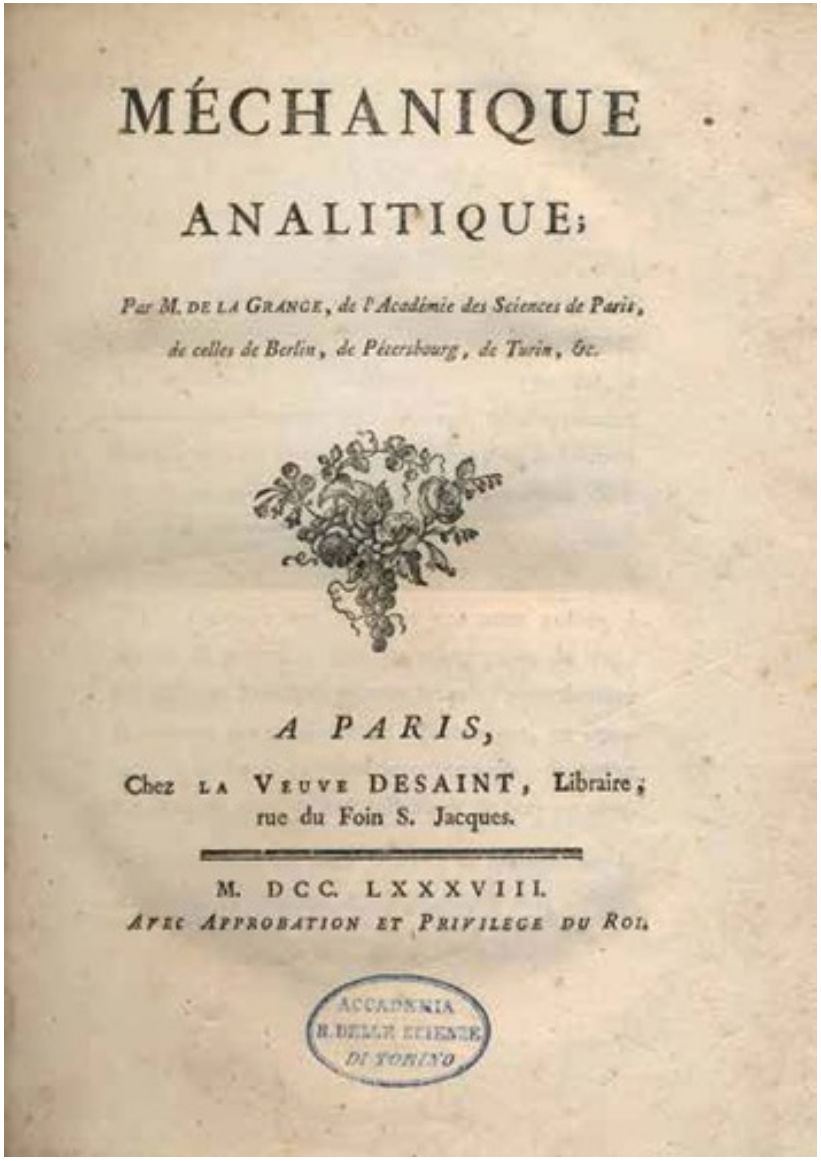
Autore *J S. NEWTON*, *Trin. Coll. Cantab. Soc.* Matheſeos Profeſſore *Lucaſiano*, & Societatis Regalis Sodali.

IMPRIMATUR.
S. PEPYS, *Reg. Soc.* PRÆSES.
Julii 5. 1686.

LONDINI,
Juſſu *Societatis Regiæ* ac Typis *Joſephi Streater*. Proſtat apud plures Bibliopolas. *Anno* MDCLXXXVII.



A Brief History of Dynamics



MÉCHANIQUE

ANALITIQUE;

Par M. DE LA GRANGE, de l'Académie des Sciences de Paris,
de celles de Berlin, de Pétersbourg, de Turin, &c.

A PARIS,

Chez LA VEUVE DESAINT, Libraire;
rue du Foin S. Jacques.

M. DCC. LXXXVIII.
AVEC APPROBATION ET PRIVILEGE DU ROI.

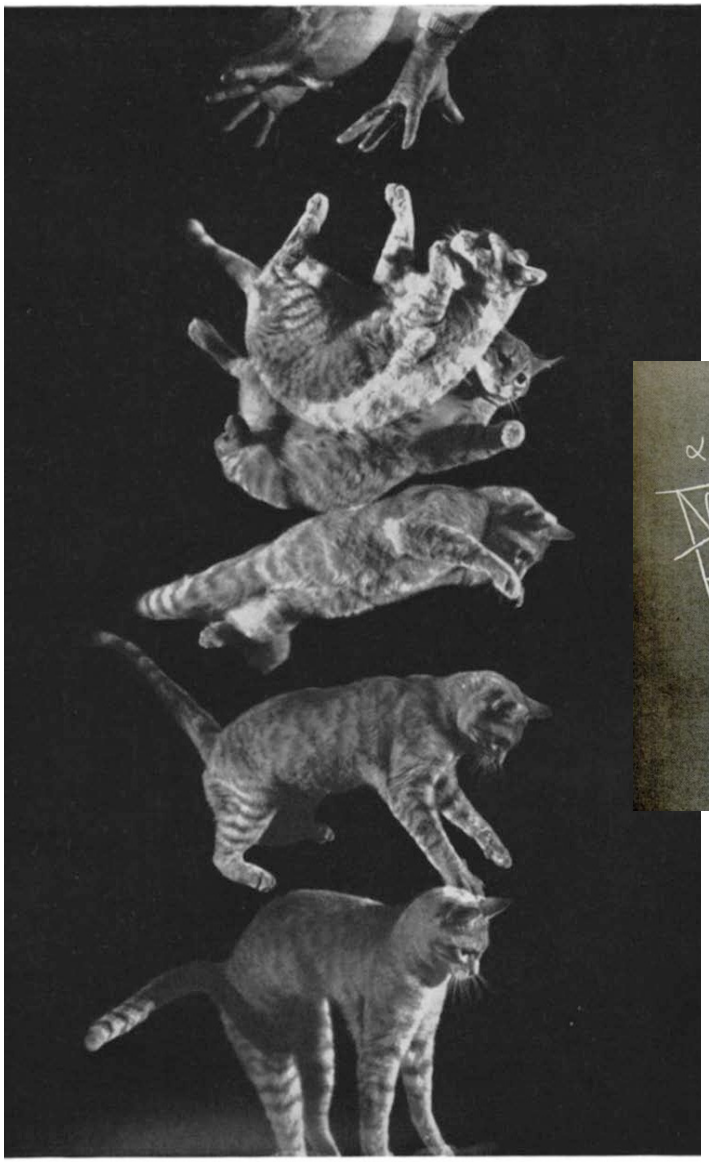
$$\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}}\right) - \frac{\partial L}{\partial q} = Q$$

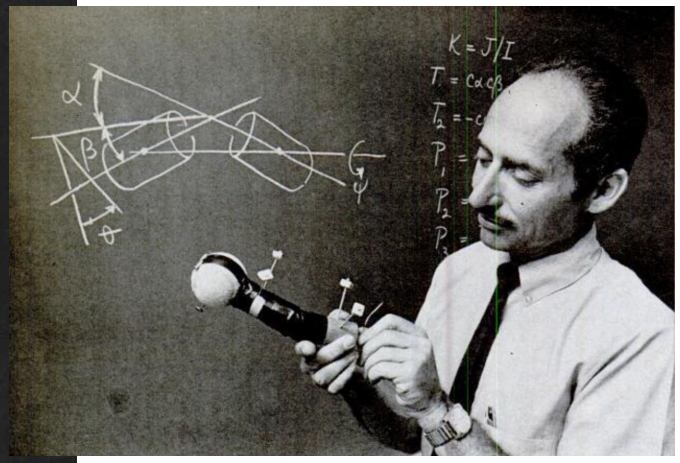
A Brief History of Dynamics

$$\mathcal{S} = \int_{t_0}^{t_f} L(q(t), \dot{q}(t))\, dt$$

$$\frac{\delta \mathcal{S}}{\delta q(t)} = 0$$

A Brief History of Dynamics



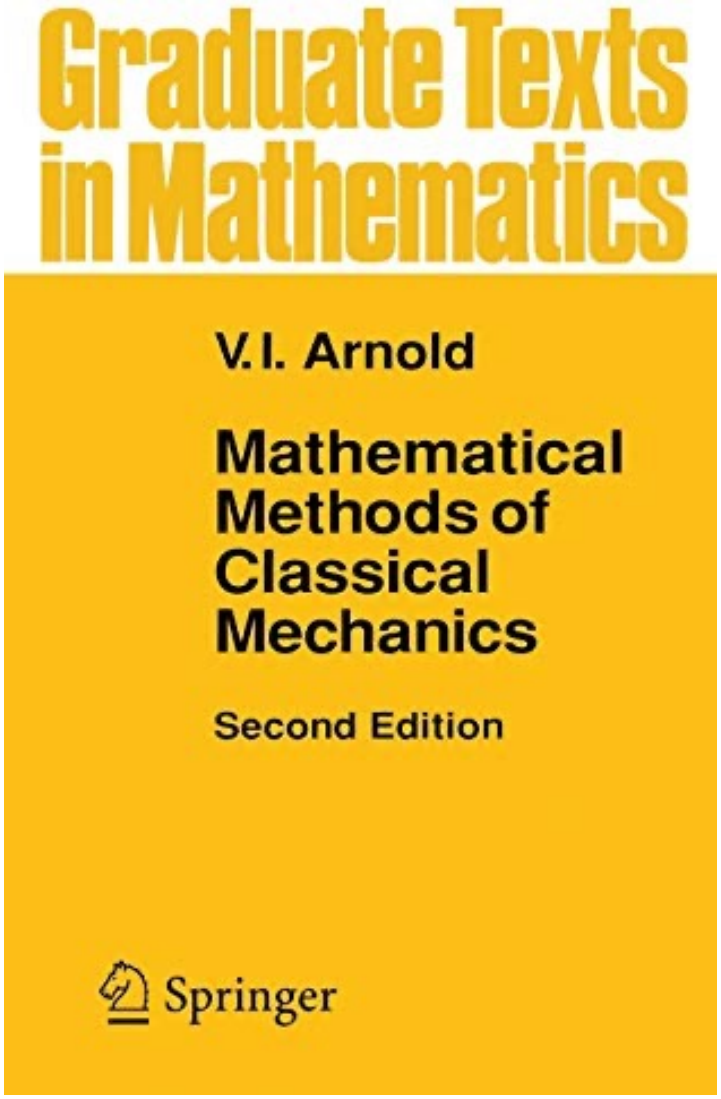


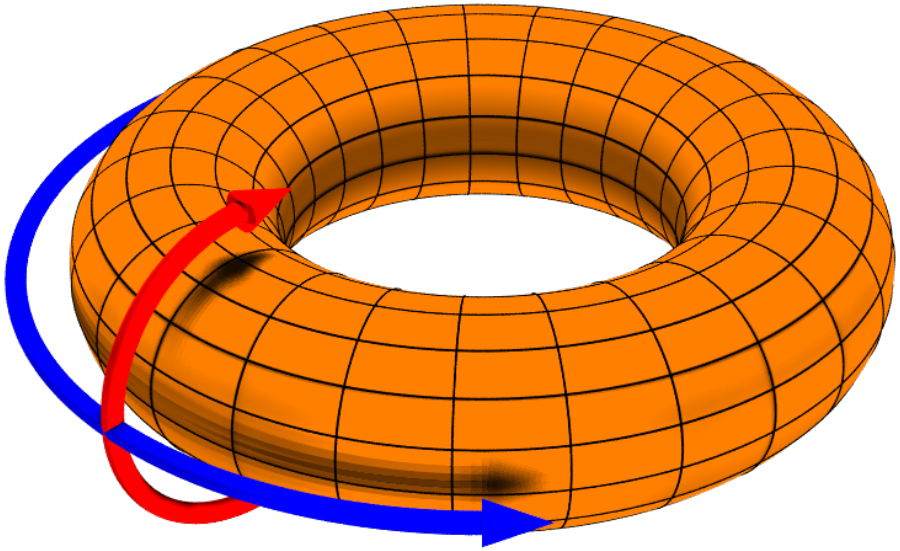
DYNAMICS:
Theory and Applications

Thomas R. Kane
Stanford University

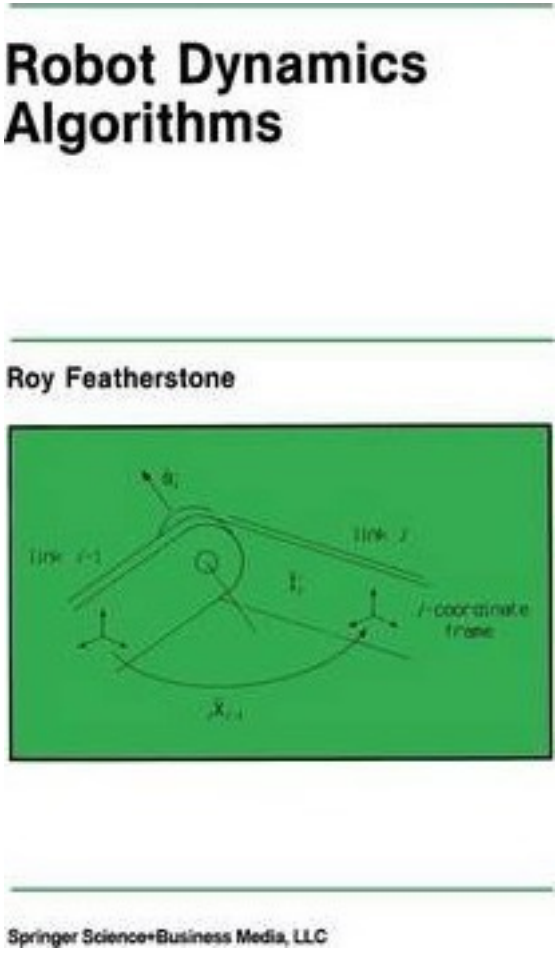
David A. Levinson
Lockheed Palo Alto Research Laboratory

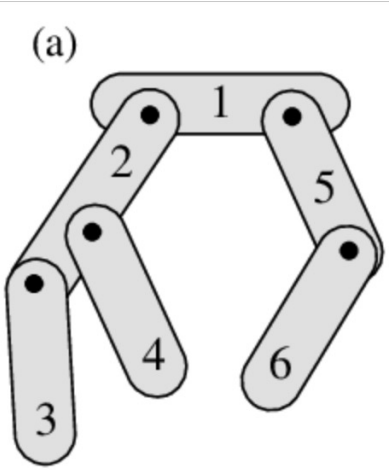
A Brief History of Dynamics

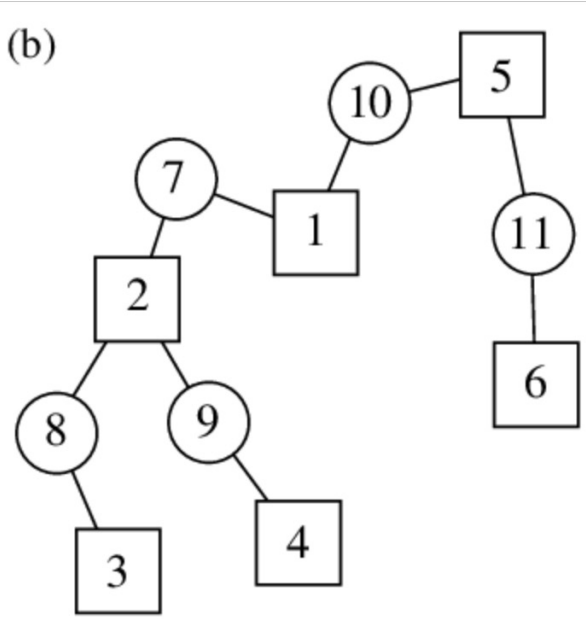




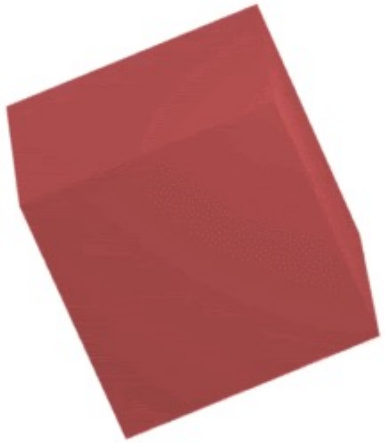
A Brief History of Dynamics

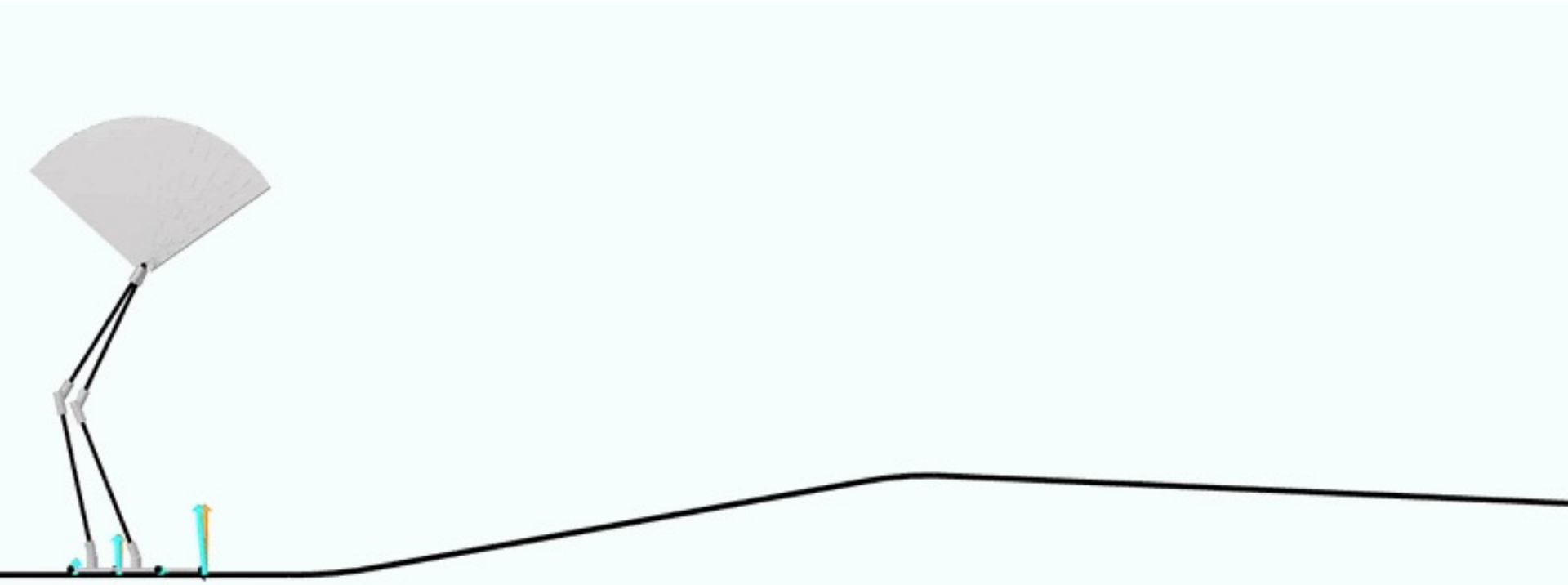




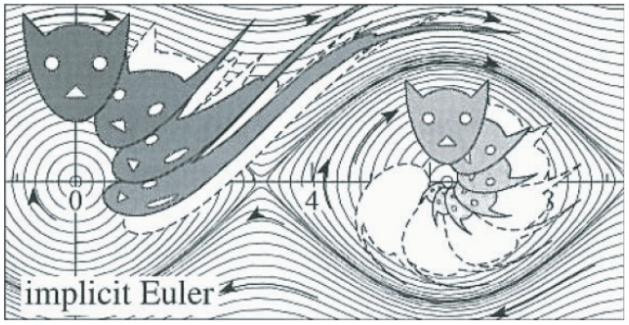


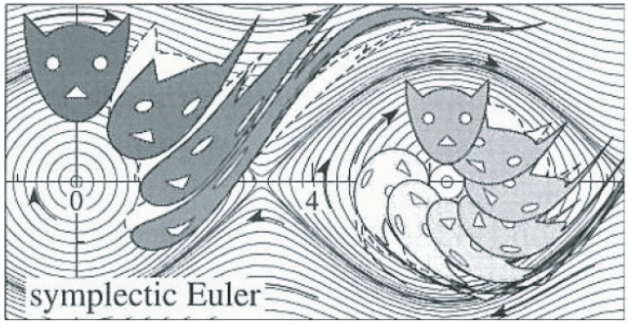
A Brief History of Dynamics





A Brief History of Dynamics





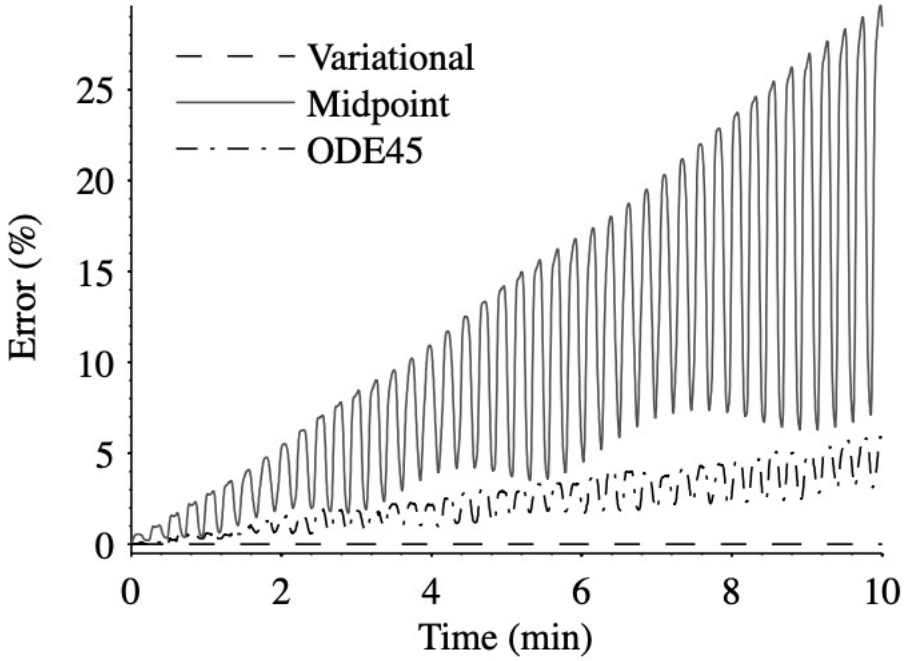


Figure 1. Momentum error for a free rigid body

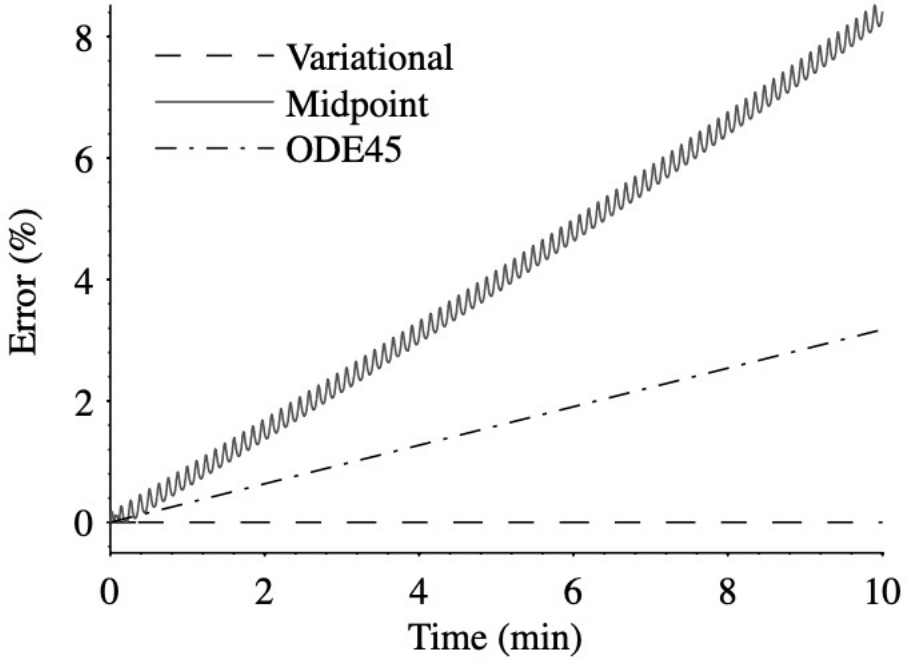
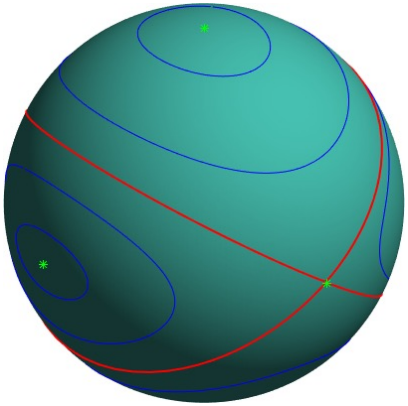


Figure 2. Energy error for a free rigid body

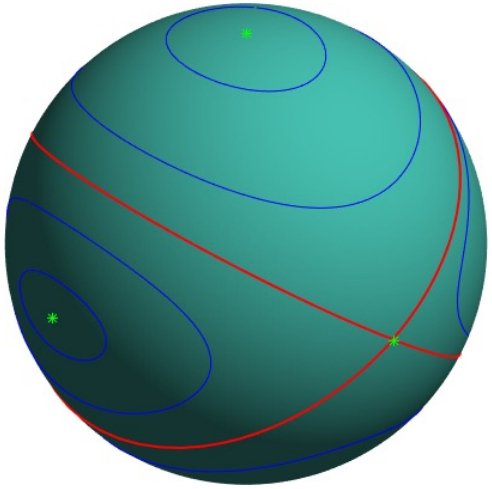
What Are We Doing Here?

- Rigid and multi-body dynamics with constraints & contact
- Classical analytical methods (Lagrange, Hamilton, etc.)
- Modern algorithmic approaches (Discrete Mechanics, Linear-Time Algorithms, Time-Stepping Methods)
- Focus on numerical implementation and robotics applications
- Homeworks (~4) + course project in groups of 1-4



Logistics

- Lectures in NSH 1305 and on Zoom (recordings will be posted)
- Notes from lectures will be posted
- Slack for course communication
- Homework will be distributed/collected through GitHub
- Office hours TBD



Assignment Zero:

Fill out course survey:
https://forms.gle/ZjMbyM9fSeQc3M5k9

Join course Slack:
https://16-715robotdynamics.slack.com/