M3-4-5 A16 Synopsis

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Professor Darryl D Holm Huxley 6M27
Imperial College London d.holm@ic.ac.uk
http://www.ma.ic.ac.uk/~dholm/

Class summary

This class explains, via self-contained examples, a general systematic framework for using ***Geometry*** in studying ***Mechanics***. Here, these terms mean the following.

- ***Geometry*** $\supset$ {Linear algebra, transformation theory, differential equations, variational calculus, Lie groups and their actions on manifolds, ideal fluid mechanics, too}
- ***Mechanics*** means "the branch of physics concerned with the motion of bodies in a frame of reference". Usually this means differential equations, e.g., $\dot{X} = F(X, t)$.
- ***study*** means "formulate and solve, so as to reveal the geometric meaning of the problem and thereby understand better how to obtain its solution".

  For example, rigid body dynamics is geodesic motion on the Lie group $SO(3)$ with respect to the Riemannian metric given by the moment of inertia. The solution may be represented as motion by smooth flows parameterised by time t that takes place along the intersections of two-dimensional surfaces in $\mathbb{R}^3$ that are level sets of the conservation laws for energy and angular momentum.

Class topics selected from the Text @ http://www.ma.ic.ac.uk/~dholm/

Geometric Mechanics I: Dynamics and Symmetry, by Darryl D Holm
World Scientific: Imperial College Press, Singapore, $\boxed{2^{nd}\ \textbf{edition}}$ (2011).
ISBN 978-1-84816-195-5

Marks

1. ***Assessed Homework:***
   - Three assignments of 5 or 6 problems each will be handed out, spaced about three weeks apart, e.g., at week 3, week 6 and week 9. Each will be due about ten days later.
   - 4th year and MSc students will also get enhanced coursework, due immediately after the Winter Break.
2. ***Final Exam:*** Three of the four questions will be taken from the assessed homework assignments.

Office hours

Arranged individually or in groups by appointment via email.