

STANFORD UNIVERSITY
Department of Aeronautics and Astronautics
AA218 - Introduction to Symmetry Analysis
Class hours: MWF 10:00 - 10:50

Topics covered

- 1) Introduction to symmetry
- 2) Symmetry of functions, dimensional analysis
- 3) Review of ODEs, first-order PDEs, state-space analysis in 2-D and 3-D
- 4) Introduction to one parameter Lie groups, examples of groups
- 5) Infinitesimal transformations, group operators, Lie series
- 6) **IntroToSymmetry.m** software package
- 7) Multiparameter groups, Lie algebras
- 8) Application to first-order ODE's, integrating factors, differential functions
- 9) Extended groups, invariance of higher-order ODEs, reduction of order
- 10) Similarity variables for PDEs, reduction of dimension
- 11) Invariant groups of the classical equations of mathematical physics
- 12) Nonlocal groups, use of symmetries to generate solitary wave solutions
- 13) Noether's theorem and the connection between symmetries and conservation laws

Tentative list of Examples.

- 1) Several examples of dimensional analysis
- 2) The two-body problem, Kepler's laws
- 3) Laminar boundary layers
- 4) Thermal gradient shocks in nonlinear heat conduction
- 5) The spherical blast wave
- 6) Similarity rules for turbulent shear flows
- 7) Problems in nonlinear wave propagation, solitary waves
- 8) Flexural waves in a thin elastic beam

Grading - Homeworks - 60%, Exam 1 - 20%, Exam 2 - 20%

Exam 1 - in class, open book, notes - May 6

Exam 2 - in class, open book, notes - June 3

Symmetry Analysis Software and sample runs can be found on my website

<http://www.stanford.edu/~cantwell/>
