

# Lie Symmetry Techniques for Partial Differential Equations

University of Newcastle, 9<sup>th</sup> - 10<sup>th</sup> May 2019

## Thursday 9<sup>th</sup> May:

We will discuss one-parameter groups of transformations. We will work through a number of examples, demonstrating how to obtain the determining equations and how to solve them to find the relevant symmetry group. Examples include:

- the linear heat equation

For this example, we will find the well known symmetry group by hand, by using Maple (where some interaction is required), and by using `dimsym/Reduce` (which requires little interaction)

- the nonlinear heat equation with  $D(u) = u^n$

For this example, we will find the symmetry group using both Maple and `dimsym/Reduce`. An additional symmetry is found for  $n = -\frac{4}{3}$ .

- the nonlinear heat equation with general  $D(u)$

In this case, we will examine the determining equations using Maple and `dimsym/Reduce`, and see how the special case  $D(u) = u^n$  arises.

## Friday 10<sup>th</sup> May:

On the second day we will discuss how to use the symmetry groups found on the first day. In particular, we will look at examples including:

- the linear heat equation – including the Boltzmann reduction, travelling waves, and more
- the nonlinear heat equation with  $D(u) = u^n$  – including travelling waves and more

We will also give a brief introduction to generalised symmetries, including nonlocal symmetries, and nonclassical symmetries.

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