# The Adaptive Method of Lines

## CDEs Group Presentation

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# Motivation

**Method of lines**

- Discretise in space (ie using fininte difference) to generate a system of ODEs.
- Solve the system using some solver such as ode15s.
- Temporal accuracy guaranteed by the ODE solver, however spatial accuracy results from the discretisation used.

# Motivation

**Mesh adaptation**

- Method of lines discretises the space uniformly.
- Using a high density uniform mesh to achieve high spatial accuracy wastes nodes in regions of low activity.
- Want to adapt the spatial mesh such that nodes are efficiently placed.

# Method of Lines - Burgers' Equation

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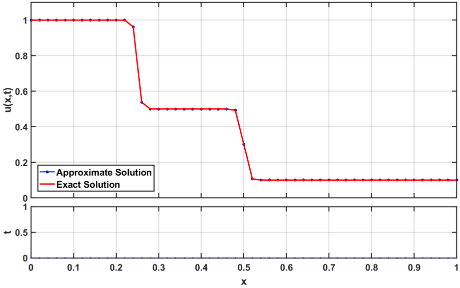

# Equidistribution Principle

**Tracking the action**

- We want to assign nodes to areas with high activity.
- Use some monitor function $m(x)$ to measure the activity in a region.
- Choose the $x_i$ such that for all $i$, $\int_{x_{i-1}}^{x^i} = \int_{x_i}^{x^{i+1}}$

# Choice of Monitor Function

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# Moving Mesh

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# Moving Mesh - KDV Equation Example 1

- Time step $= 10$

# Moving Mesh - KDV Equation Example 2

- Time step $= 2$

# Moving Mesh - Burgers' Equation Example 1

- Time step $= 0.1$

# Moving Mesh - Burgers' Equation Example 2

- Time step $= 0.01$

# Mesh Refinement

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# Mesh Refinement - Burgers' Equation Example 1

- Time step $= 0.1$

# Mesh Refinement - Burgers' Equation Example 2

- Time step $= 0.01$

# Dynamic Method

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# Dynamic Method - Burgers' Equation Example

- Number of mesh points $= 51$

This is the last slide.

Any questions?