# Eilmer

CSCI 5636 Project Proposal

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# Eilmer is a Compressible Flow Solver for 2D and 3D Applications

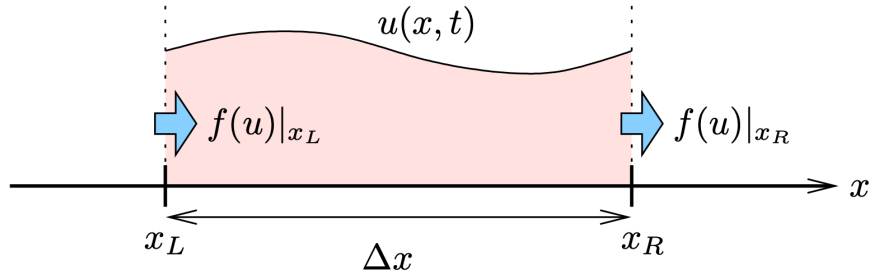
- Eilmer's main application is hypersonic flows
  - Species mass, momentum, energy, vibrational energy
  - High-temperature thermochemical nonequilibrium
  - Shock-capturing and shock-fitting capabilities
  - SA, κ−ω, IDDES turbulence models
  - Coupled heat transfer

$$\frac{\partial \rho_s}{\partial t} + \frac{\partial (\rho_s u_j)}{\partial x_j} = -\frac{\partial}{\partial x_j}(\rho_s v_{j,s}) + \dot{w}_s$$

Viscous mass diffusion

Chemistry source

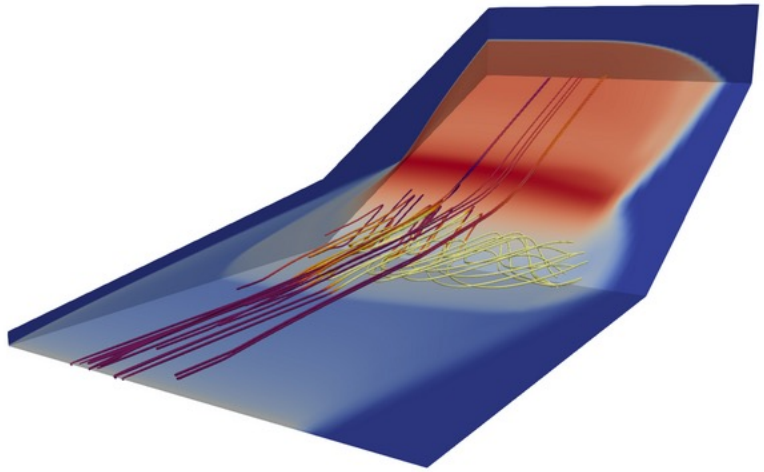
- Eilmer uses a Finite Volume Formulation to solve NS
  - Steady state jacobian-free newton-krylov solver
  - Implicit integrators for stiff systems (nonequilibrium chemistry)
  - Partitioning via Metis
  - Unstructured and structured grids
  - Highly parallel, GPU ready



# Eilmer is Open Sourced GPL3 Licensed

- Primarily maintained out of University of Queensland
  - cns4u -> mb_cns -> mb_cns2 -> Elmer -> Elmer2 -> Eilmer3 -> Eilmer4
  - Eilmer4 started in 2015. Has rapidly grown in size.
  - Principle Developers: Drs. Rowan Gollan, Kyle Damm, Nick Gibbons, Peter Jacobs
  - Majority written in D (?) and Lua

- Eilmer's development community is active
  - 12 commits per week and active GitHub issue page
  - 14 contributors in the past year
  - Automated test suites and smoke tests
  - Highly documented (User guides, reference manuals)



# Potential Contributions

- Add additional TVD schemes for higher shock resolution
  - Van Albada and Venkatakrishnan flux limiters are currently implemented
  - Van Leer, superbee, minmod are potential options
- Implement additional turbulence models
  - Baldwin-Lomax single equation
- Introduce a new example problem
  - Cone or double cone (axisymmetric)