Polymer Flow Processing Design

- Simulation/Design Approach
  - Nonlinear FEA solved via NR iteration
  - DSA via Adjoint variable and DD methods
  - Gradient-based optimization (DOT, VRAND)

- Injection Molding Process Design
  find: gate locations, gate pressures
  to min: fill time
  subject to: injection rate
             clamp force
             flow front uniformity

- Sheet extrusion die cavity design
  find: die cavity geometry, inlet pressure
  to min: inlet pressure
  subject to: exit velocity uniformity
             prescribed exit flow rate

- Injection Molding Process Design

  - Gate locations:
    - Gate 1: $b_1 = 0.5$
    - Gate 2: $b_2 = 0.733$

  - Fill time:
    - Initial Design: 4.75 sec
    - Optimal Design: 2.90 sec
    - Improvement: 39%

  - Initial Design:
    - Gate 1: $b_1 = 0.5$
    - Gate 2: $b_2 = 0.5$
    - Fill time: 4.64 sec
    - Half-gap: 2.82 mm

  - Optimal Design:
    - Gate 1: $b_1 = 0.412$
    - Gate 2: $b_2 = 0.733$
    - Fill time: 2.90 sec
    - Half-gap: 2.41 mm

- Velocity Vectors
  - Initial Design
  - Optimal Design

- Distance along die exit (mm)
  - LDPE @ 473K
  - LDPE @ 453K
  - LDPE @ 433K

- Die flow
  - Initial Design
  - Optimal Design

-half-gap (mm)