Rensselaer

# Toward High-Performance Computing Support for the Simulation and Planning of Robot Contact Tasks

**Jeff Trinkle and Chris Carothers, RPI CS, Troy NY, USA**

**Dan Negrut, ME, U. of Wisconsin, Madison, Wisconsin, USA**

Rensselaer

# Workshop Goals

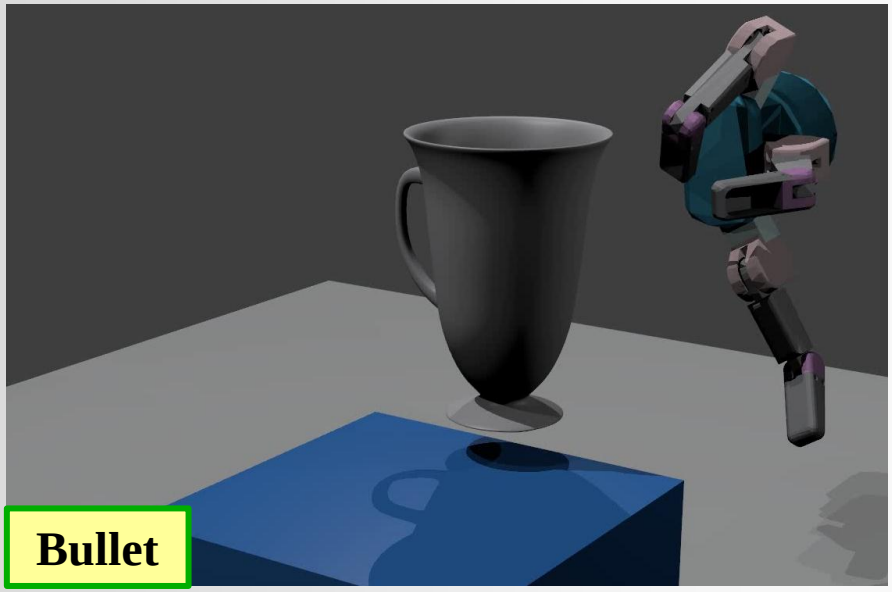
- **Day 1** – Assess the state of the art and future needs in multibody simulation with contact.
  - Simulation capabilities
  - Future needs in robotics, engineering, games, etc.
  - Guidelines for model/method selection

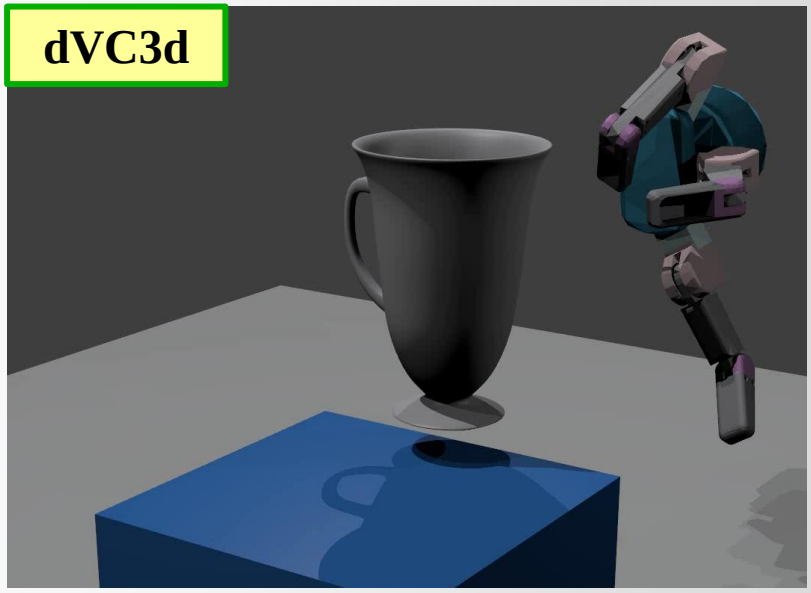
- **Day 2** – Discuss the possibility of an open-source tool with 24/7 support offered on a HPC platform.
  - Possible break-out groups:
    - Software base and user support
    - Hardware and platforms
    - Validation and benchmarks
  - Possibly apply for NSF Community Infrastructure – Acquisition, Development, Deployment, and Operation grant

Rensselaer

# Challenges for Simulator Users

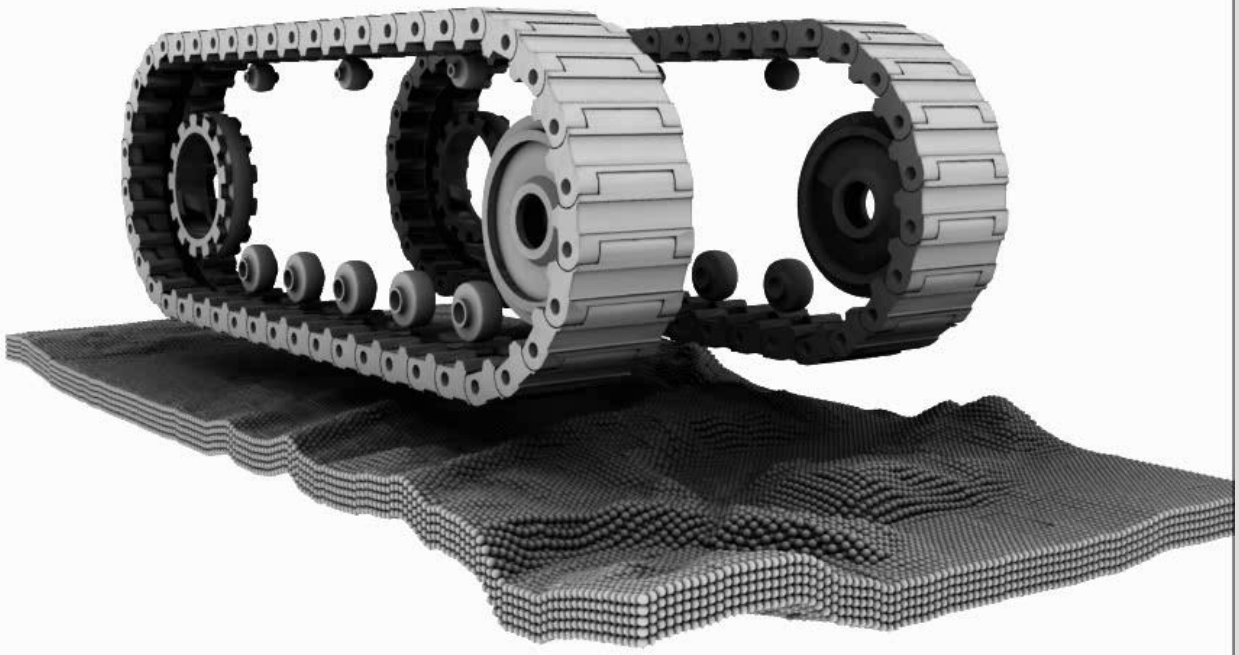
- My group compared dVC3d to Bullet.
- We could not stabilize Bullet.
- Could a support infrastructure have solved this?
- Which model/simulator should I use for my problem?



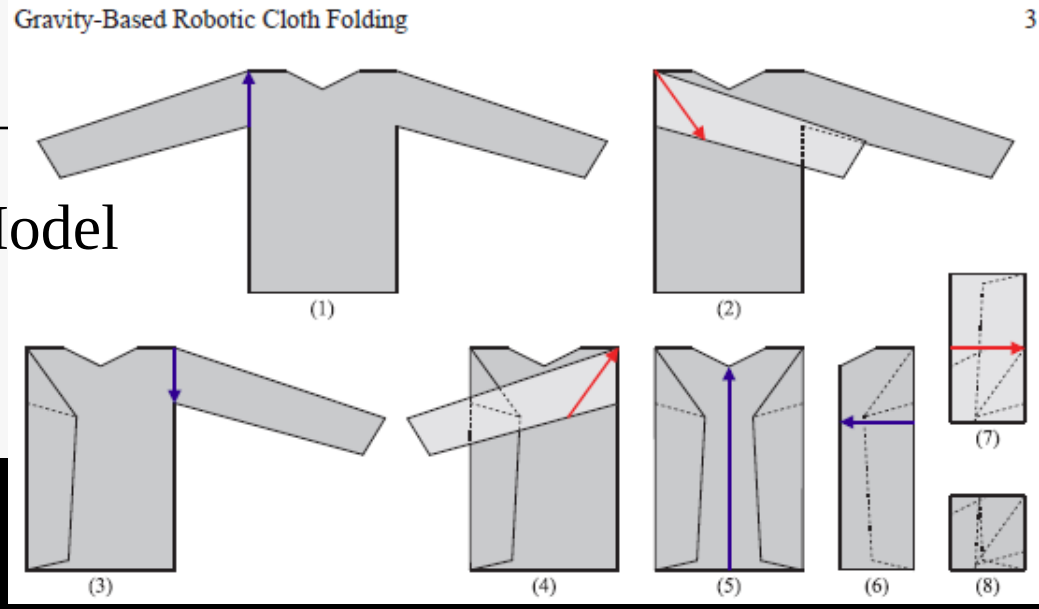
# Engineering Analysis with Chrono Engine





# Kinematic/Quasistatic Model

- Folding planning
  - Cloth is rigid panels connected by revolute joints
  - Who would have chosen rigid models with gravity bending




Rensselaer

# Morning Schedule 27, June

- 9:00 – 10:30: **Session 1: Oral Presentations**
  - 9:00: **Erwin Coumans** (AMD), "*OpenCL accelerated rigid body dynamics and collision detection*."
  - 9:30: **Sidd Srinivasa** (RI, CMU), "*Mobile manipulation in the real world*."
  - 10:00: **Dan Negrut** (ME, Wisconsin), "*Enabling high performance computational dynamics in a heterogeneous hardware ecosystem*."
- 10:30-10:35: **Poster Teasers**:
  - Drumwright, Goldman, Moisio, Mazhar, Schindler
- 10:35 – 12:00 **Session 2: Poster Presentations**
- 12:00 – 13:30 **Lunch**
- 13:30 – 15:00 **Session 3: Oral Presentations**

Rensselaer

# Early Afternoon Schedule 27, June

- 13:30 – 15:00: **Session 3: Oral Presentations**
  - 13:30: **Kevin Lynch** (Northwestern), "*Simulation and experiments of vibratory manipulation: Rigid bodies on a vibrating surface*."
  - 14:00: **Dinesh Manocha** (UNC), "*Real-time collision and contact computations using multi- and many-core processors*."
  - 14:30: **Todd Murphey** (Northwestern), "*Variational integration methods for simulating and designing systems with simultaneous impact*."
- 15:00 – 15:30: **Coffee**
- 15:30 – 17:00: **Session 4: Oral Presentations**

Rensselaer

# Late Afternoon Schedule 27, June

- 15:00 – 15:30: **Coffee**
- 15:30 – 17:00: **Session 4: Oral Presentations and Discussion**
  - 15:30: **Dinesh Pai** (UBC), "Contact resolution with Eulerian solids simulation."
  - 16:00: **Danny Kaufman** (UNC), "*Moving forward in contact, impact, and dissipation: challenges and choices for computing contact-constrained trajectories*."
  - 16:30: **Todd Murphey** (Northwestern), "*Variational integration methods for simulating and designing systems with simultaneous impact*."
  - -17:00: **Jeff Trinkle** (RPI): Wrap-up

- TOMORROW – We start at 8:30
- 8:30 – 9:30: **Session 5: Breakout Groups**
  - Break-out groups: Software and support, hardware, validation and benchmarks

Rensselaer

# Morning Schedule 28, June

- 8:30 – 9:45: **Session 5: Break-out Groups**
- 9:45 – 11:00: **Session 6: Group Discussion**
- 11:00 Adjourn

- **Join RSS program**
- **11:00 – 11:30: Coffee on RSS schedule**