P&G Modeling & Simulation

The Modeling & Simulation Behind Improving Everyday Life

Tom Lange

Director,

Modeling & Simulation

Corporate R&D

The power to transform.

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Investors Know P&G …

- Large, Global, & Successful Consumer Goods Company
  - Sales: $82.6 Billion FY June 30th, 2011
  - Net Earnings: $11.8 Billion
  - 4.2 billion Consumers purchase a P&G product about 40 Billion Times a year.
- Builds lasting shareholder value
  - P&G has paid Dividends (Without Interruption) Since 1890
  - 55 consecutive years of Increasing Dividend Payments at a annual compound average rate of ~ 9.5%
  - Market Cap ~ 181 billion COB 2/12012
- Innovates to Grow:
  - Invest about $2 Billion/yr in R&D…

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P&G *Consumers* … Know Us by Brands

Beauty & Grooming

Health & Well-Being

Household Care

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23 Billion $ Brands…

Beauty & Grooming

Health & Well-Being

Household Care

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Why *"rocket science"*?

For such everyday things?

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Performance Contradictions…

Materials …

- strong but soft
- stretch not break,
- breath but contain,
- break…not tear.

Packages …

- creative design drives sales, but makes it harder to pack
- strong but light,
- never leak…but open easily.

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Performance Contradictions…

Formulations …

- protect fabrics … but remove stains.
- Be compact, but used easily.

Liquids …

- mixtures can't separate,
- must dispense easily… but stay where applied.

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Scale: How to Sell $1B

P&G makes billions of things…
…and sell them for < $10

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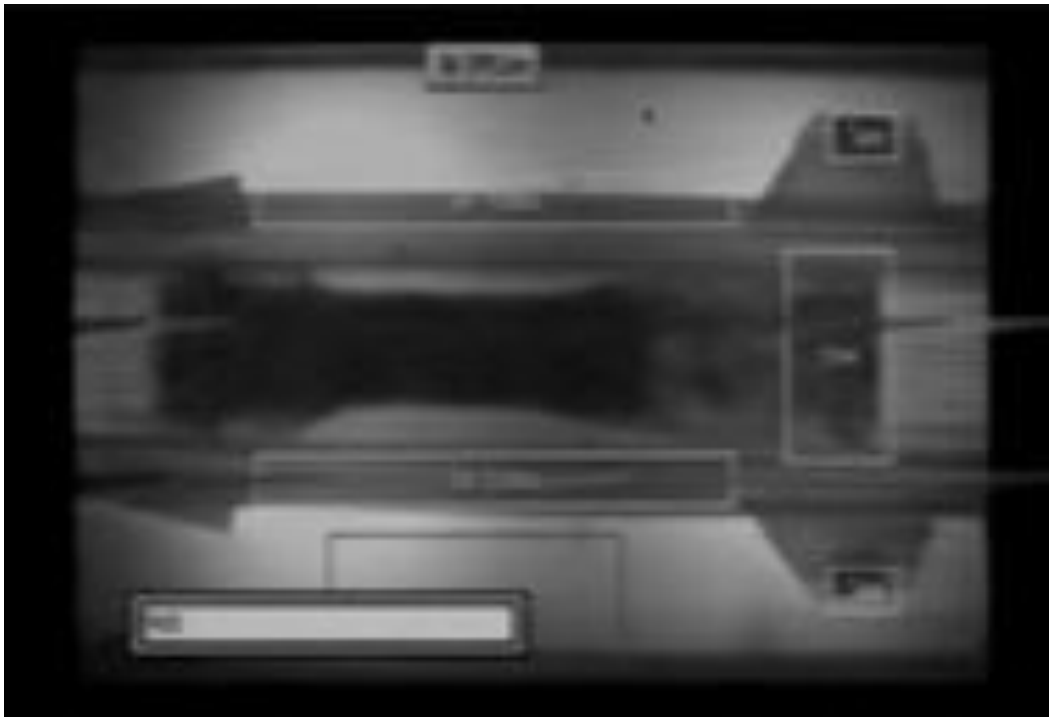
Scale: Make a Billion Diapers…

How long does it take to make a billion Pampers?



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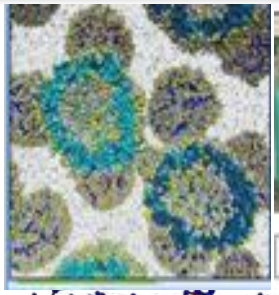
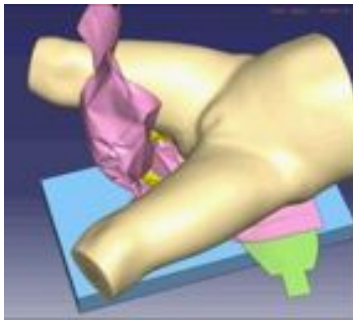
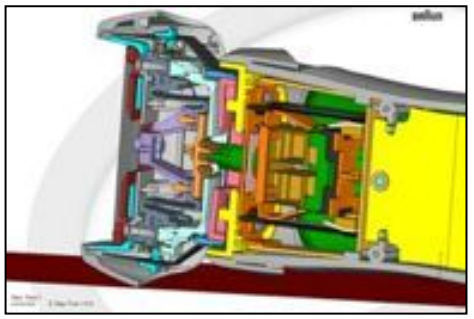
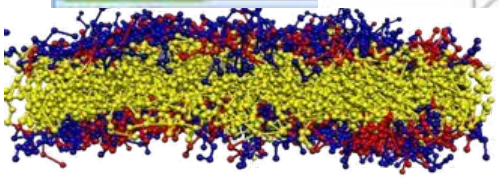
…Atoms to the Enterprise

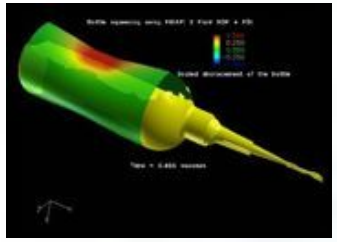
Product/ Materials/ Device/ Package



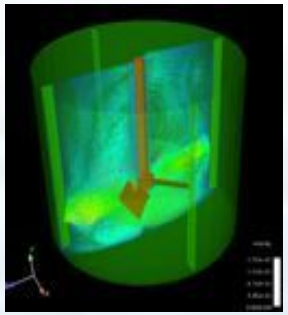


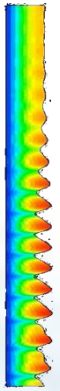


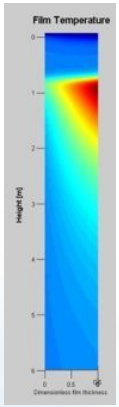


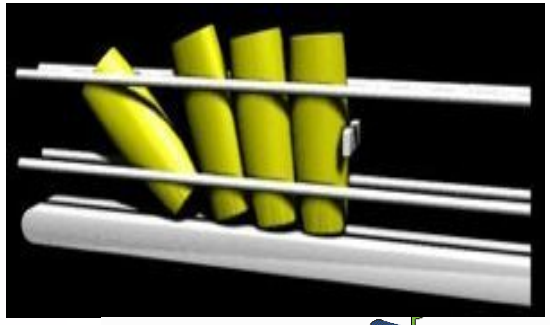


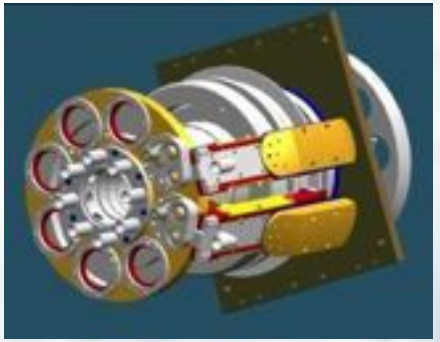
Process

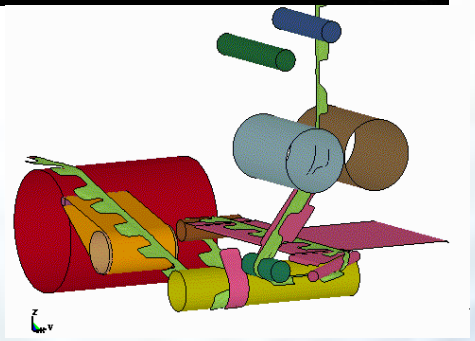




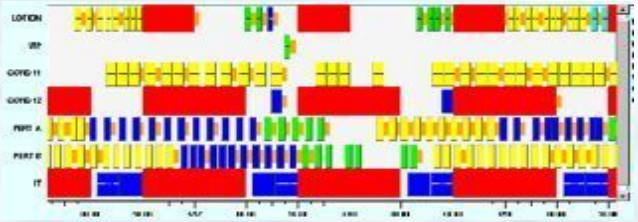








Production Plan & Schedule, Reliability



Converting & Machines

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P&G & NITRD…

Our Technical Challenges lead to collaboration with the best Scientists

…Since 2009

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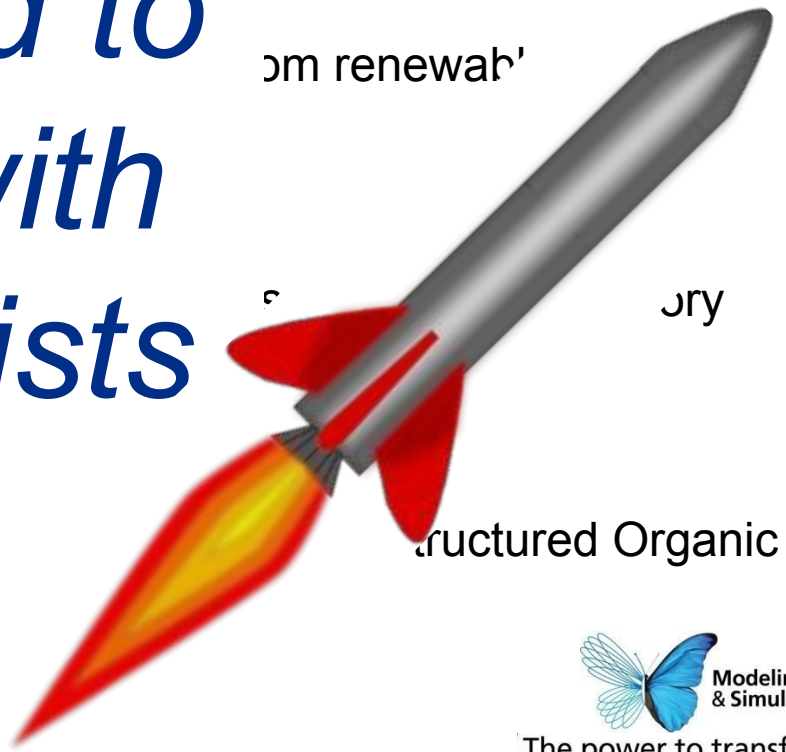

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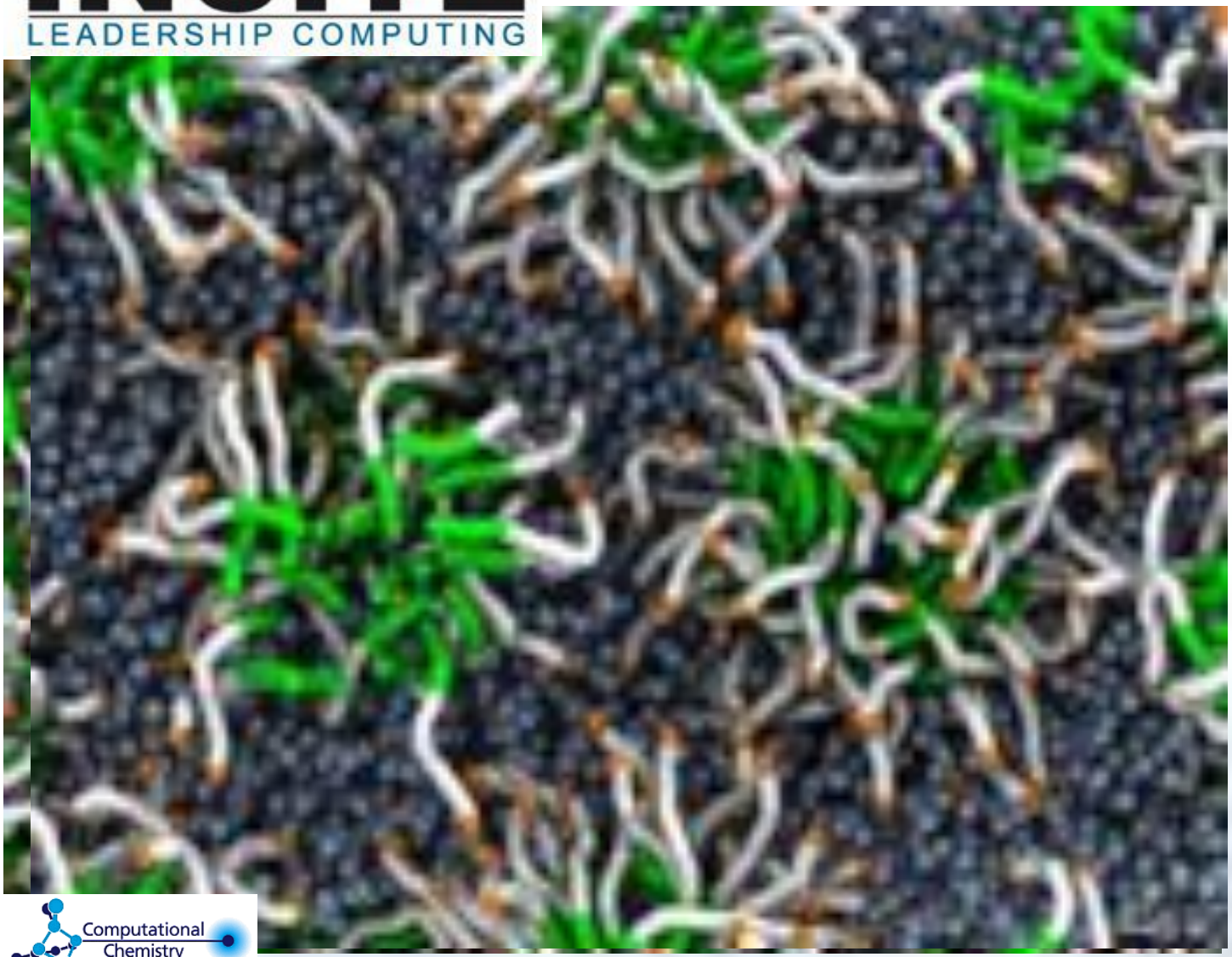
U.S. DEPARTMENT OF ENERGY
INCITE
LEADERSHIP COMPUTING

OAK RIDGE NATIONAL LABORATORY
Managed by UT-Battelle for the Department of Energy



Dr. Michael Klein, Temple University

"Coarse Grained Molecular Dynamics Studies of Vesicle Formation and Fusion"

Computational Chemistry
CADMol

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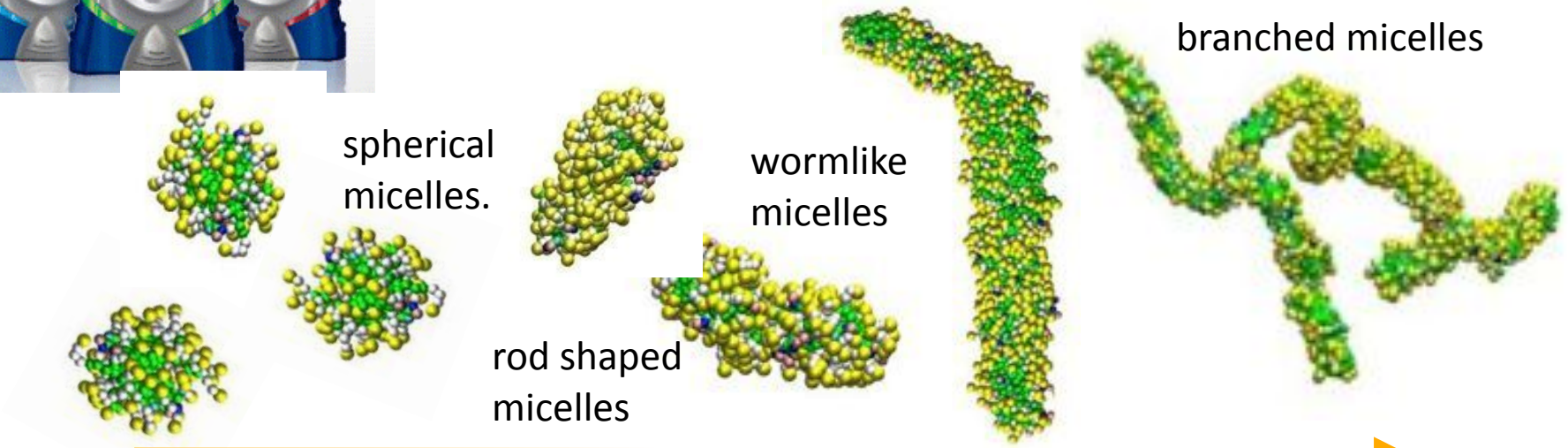
Understanding Body Wash Formulations – Micelles!

Why are some formulations thicker (e.g. rheology)

at *different* concentrations?



Computational Chemistry
CADMol

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Solid Mechanics:

- **Rigid Body Kinematics**
- **Finite Element Analysis (FEA):**
  - Implicit
  - Explicit
  - Linear
  - Non-linear
  - Massive Contact
  - Complex non-metal Material Models: High Strain Rates 1/500 Seconds, Elastic-plastic, Hysterisis: Visco-Elastic, Visco-Plastic

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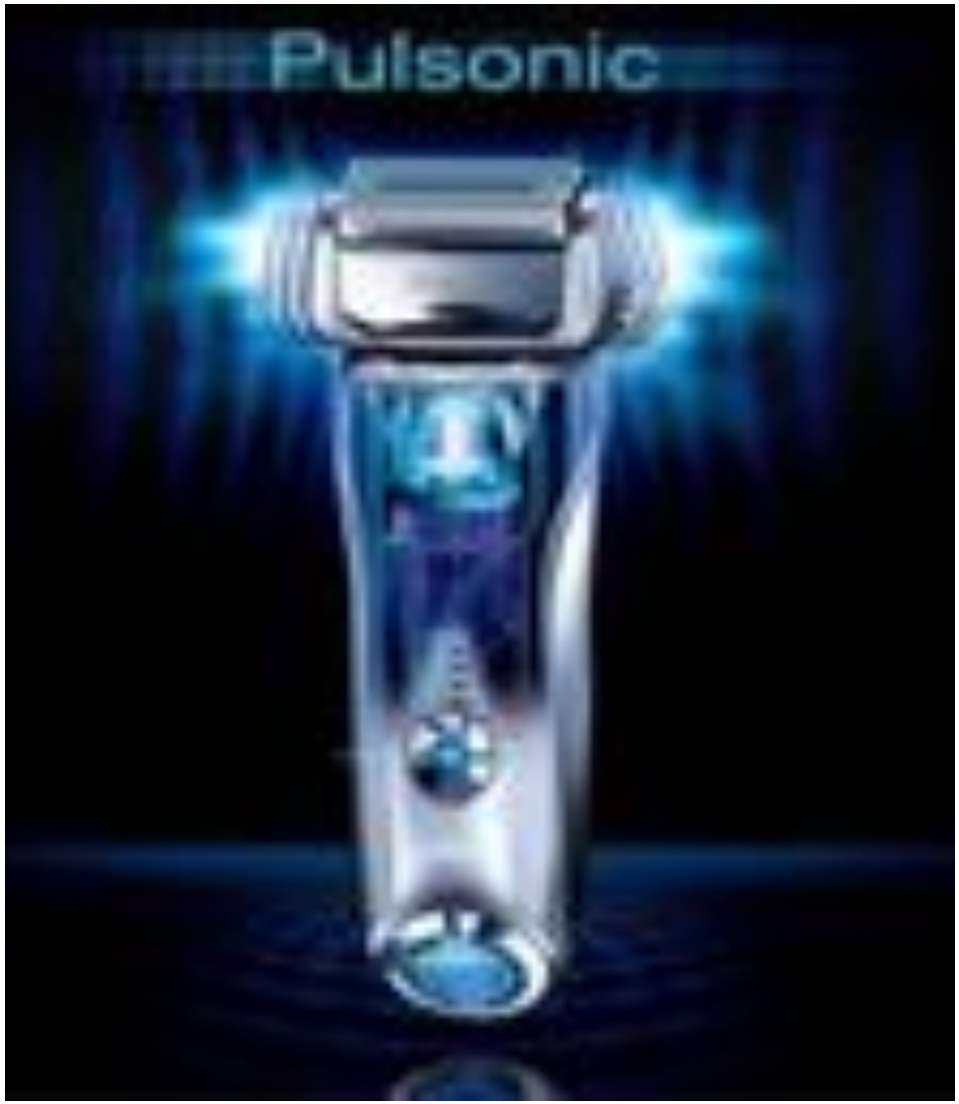
The new premium shaver …



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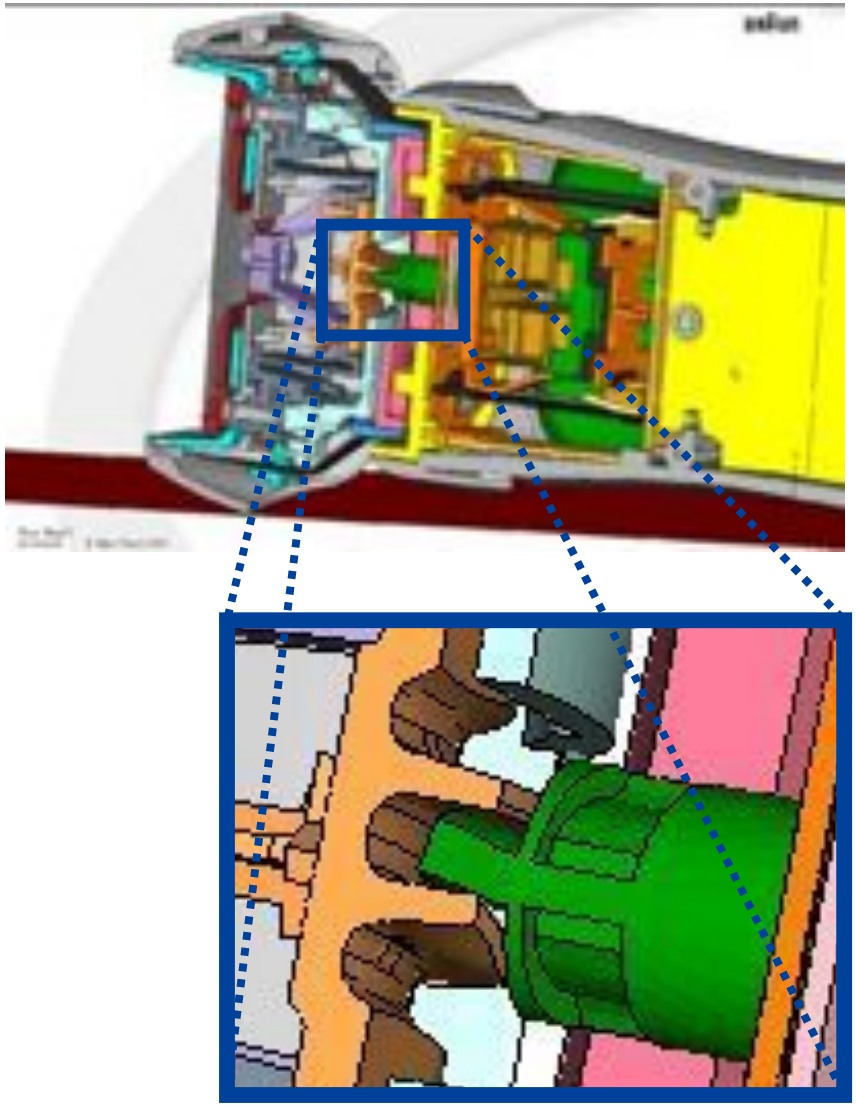
Bathroom Floor Drop



Lots of Small Parts...
…Everyone must work!

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Fluids / Thermal

- **Computational Fluid Dynamics (CFD):**
  - Free Surface Flow
  - Contained Turbulent Flow
  - Multi-Phase Flows
  - Creeping & Low Reynold's Number Flows
  - Non-Newtonian & Visco-Elastic Material Properties
  - Flow in Porous Media

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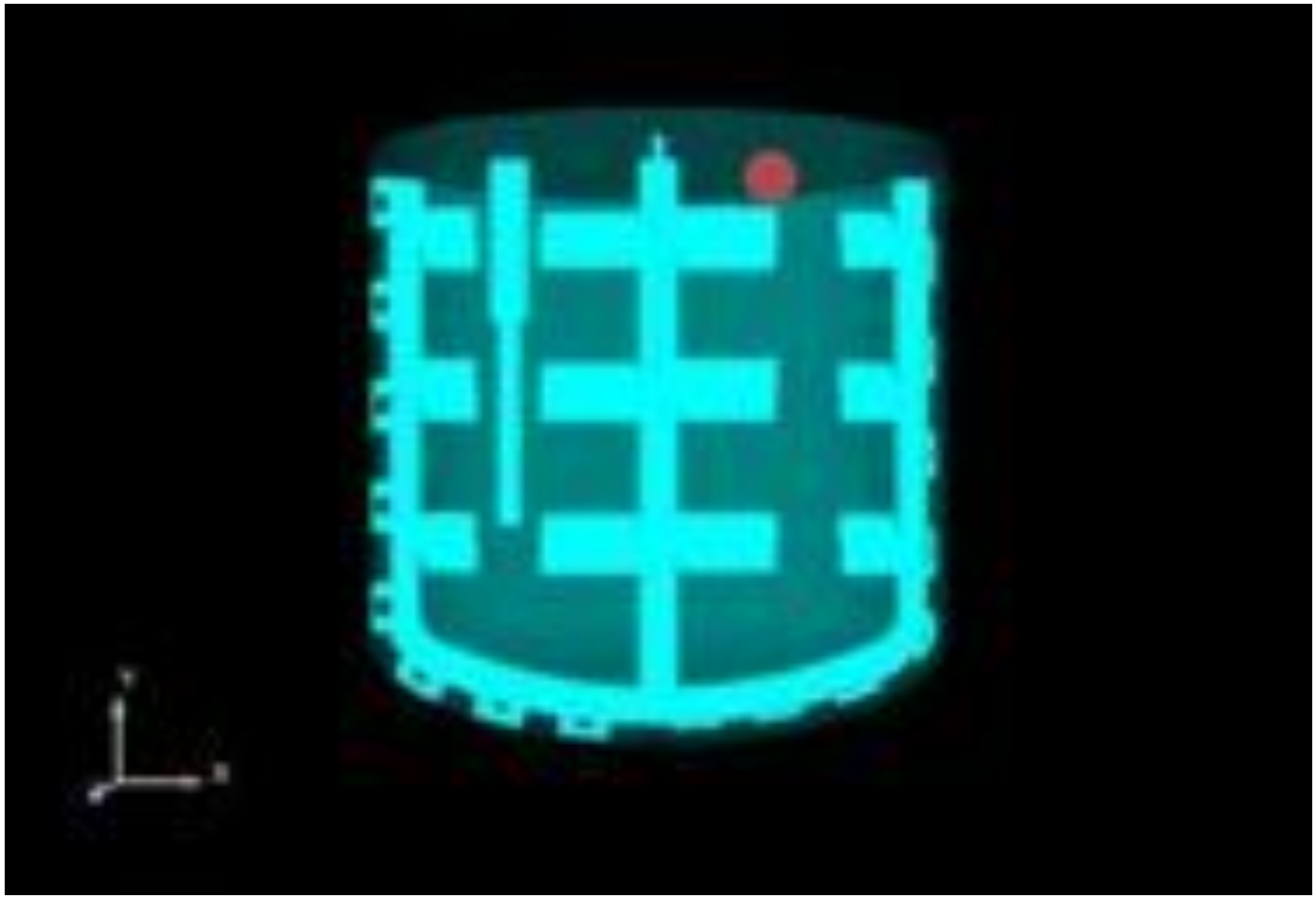
Mixing Non-Newtonian Fluids



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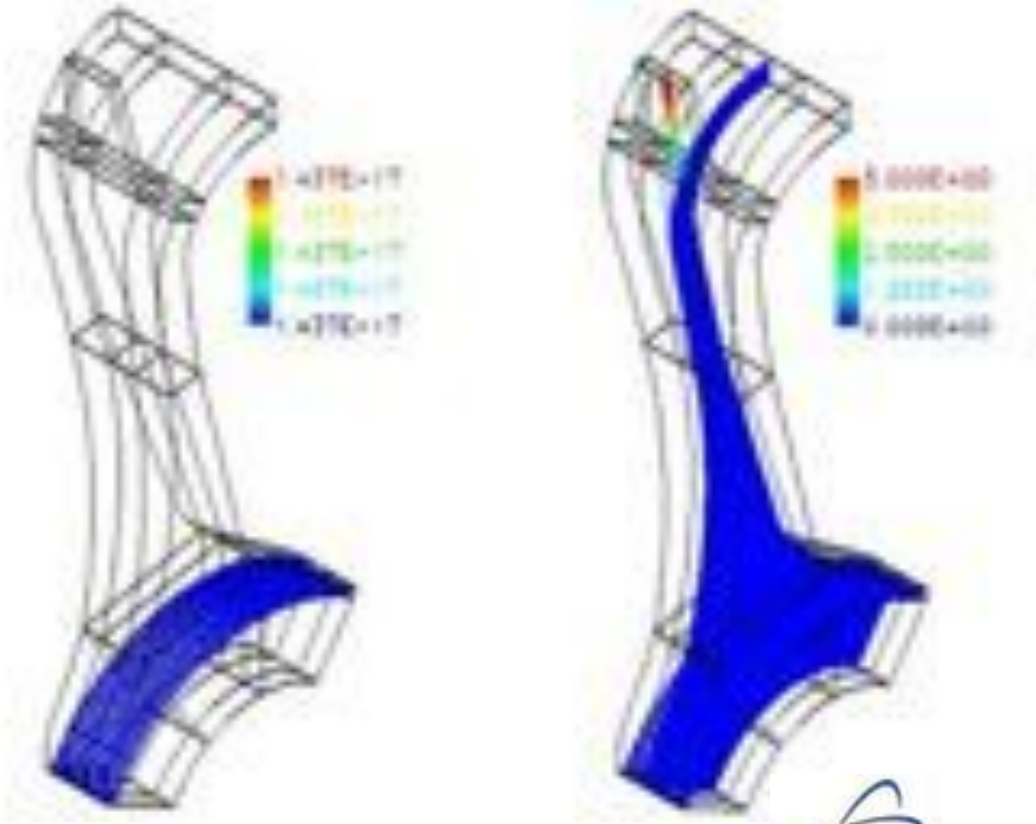
Fluids: Making Absorbent Diapers

Multi-Phase Turbulence… w/ Material Accumulation At the Boundaries



CFDlib w/ FLIP Markers
(Bucky Kashiwa)
@ Los Alamos National Labs

Los Alamos
NATIONAL LABORATORY
EST. 1943

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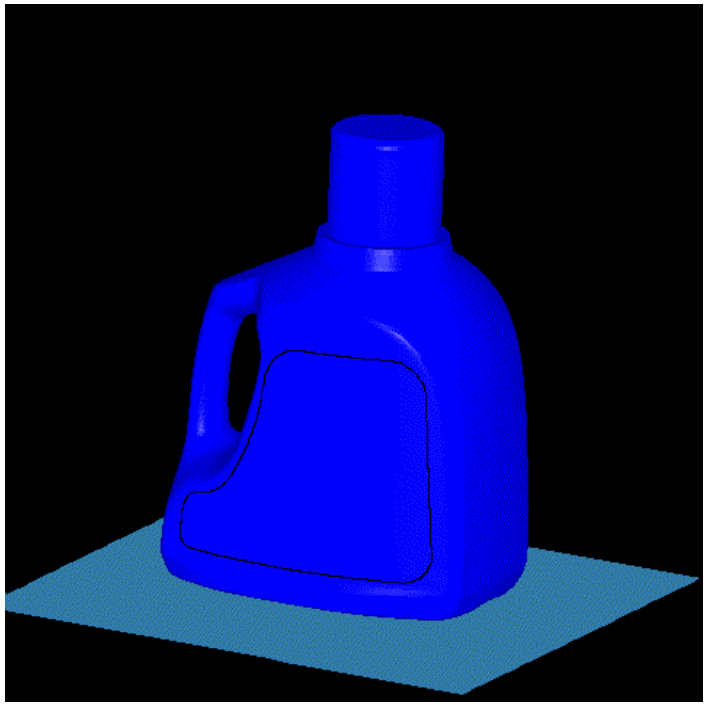
Bottle Drop Simulation

What You Don't Want to
Happen In Store Or Your Laundry Room!



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Looking Ahead… Rehearse Reality!

- Tackle ‘Bigger’ more complex Problems more Completely
- Solve Larger equation sets…
- Do parametric studies(UQ) vs. point estimate Calculations
- ‘Turbo Tax©’ Complexity… Democratize Analysis to non-analysts

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