

The Modeling & Simulation Behind Improving Everyday Life

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Modeling &
Simulation
Corporate R&D



The power to transform.



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...



The power to transform.



Consumers ... Know Us by Brands

Beauty & Grooming

Health & Well-Being

Household Care

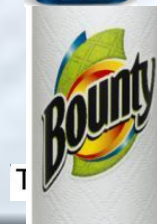


Beauty & Grooming



Health & Well-Being

Household Care



P&G

Why “rocket science”?



For such
everyday
things?



Modeling
& Simulation

The power to transform.

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.



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.





Scale: How to Sell \$1B



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

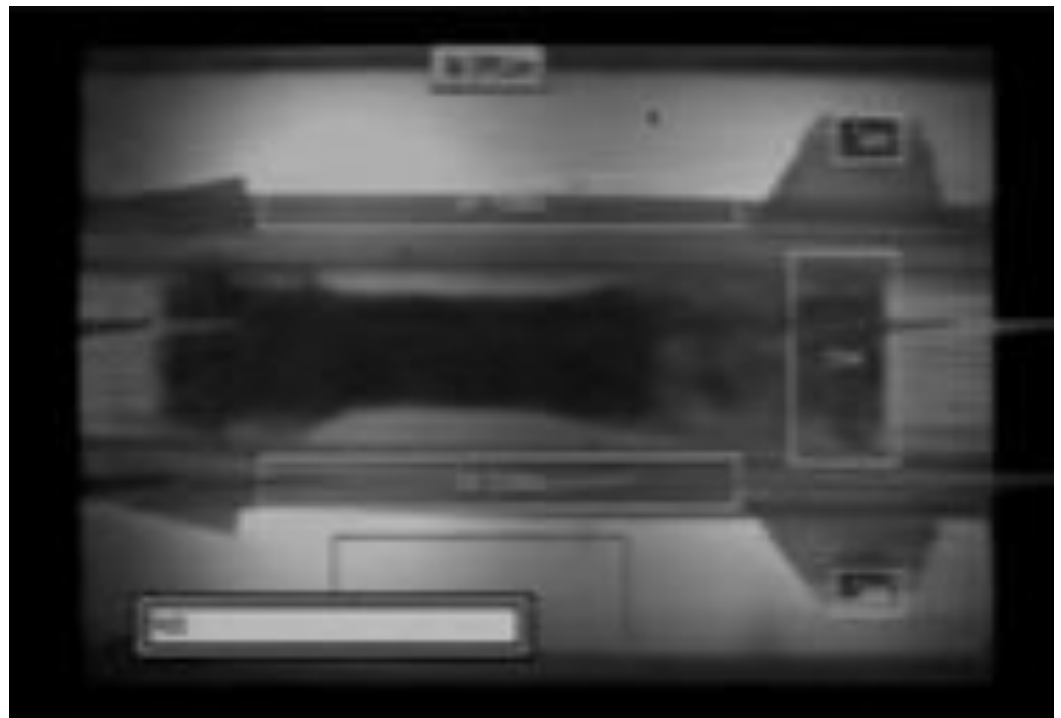


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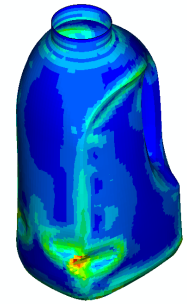
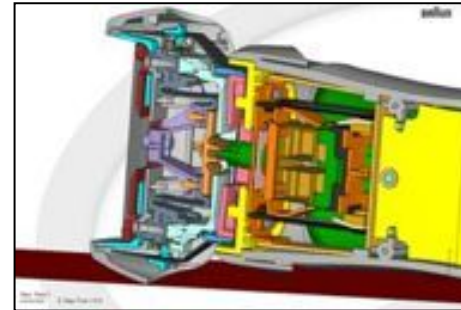
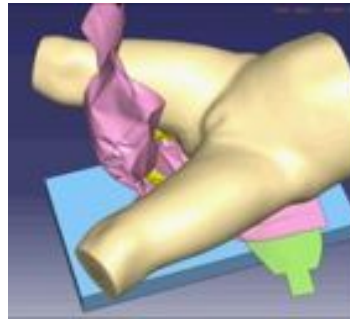
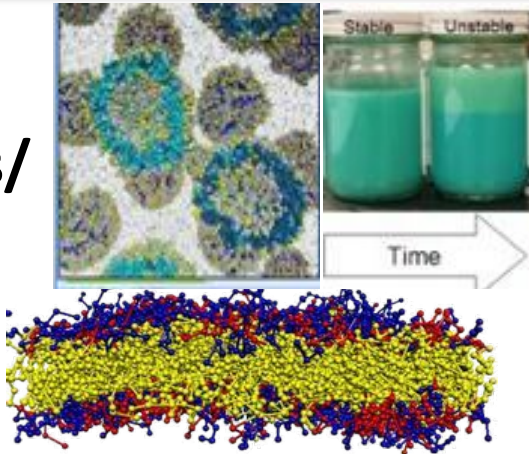
Scale: Make a Billion Diapers...

How long does it take to make a billion Pampers?

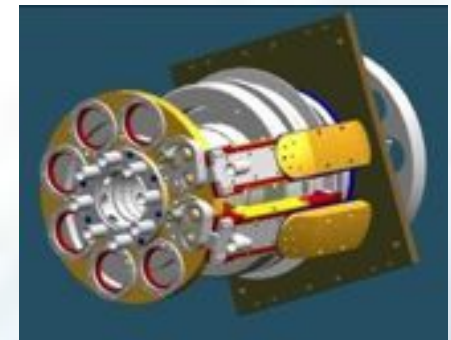
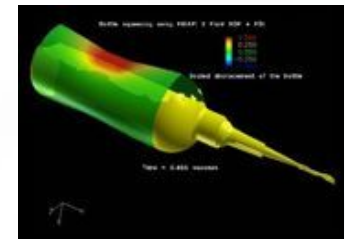
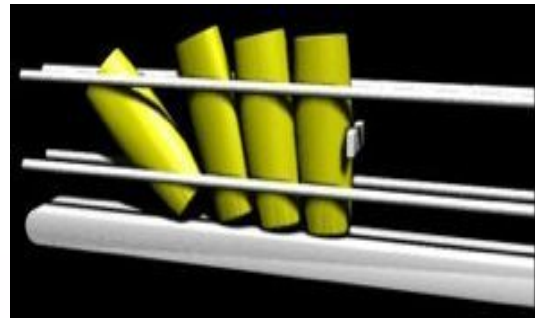
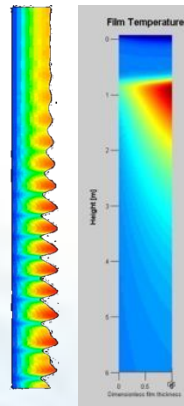
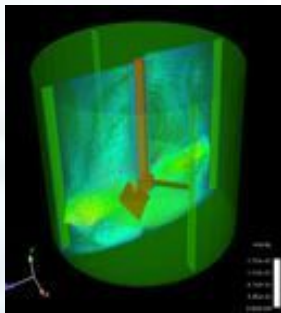


...Atoms to the Enterprise

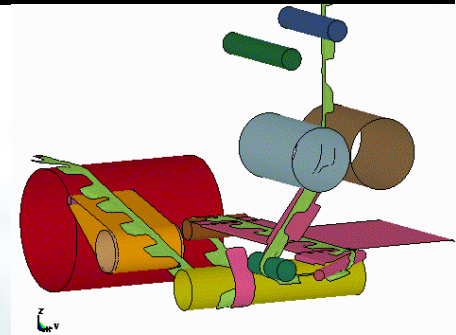
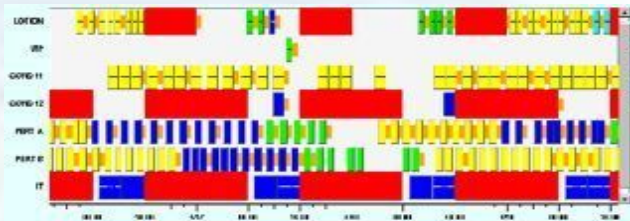
**Product/
Materials/
Device/
Package**



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

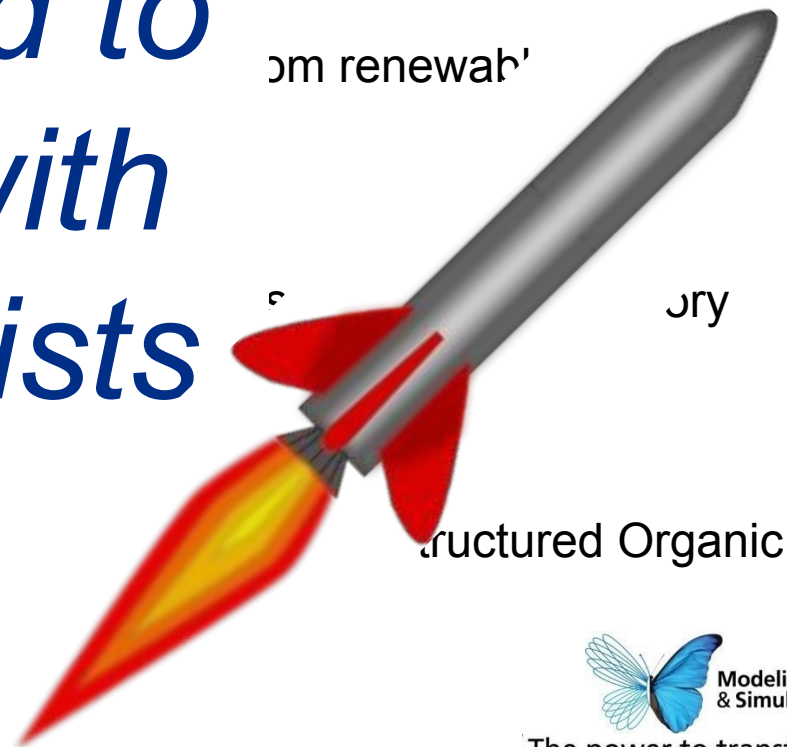
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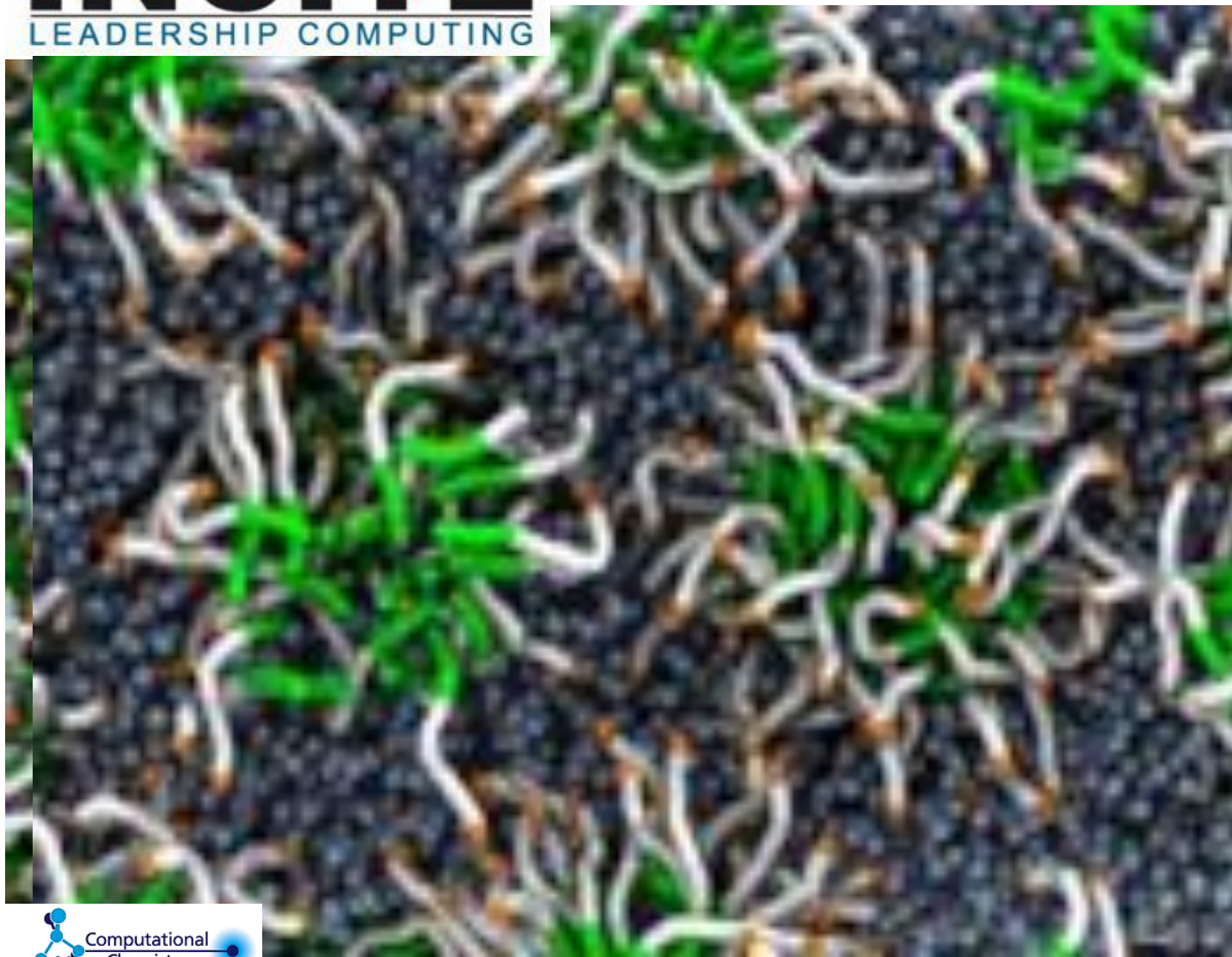
structured Organic



... since 2005



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Dr.
Michael
Klein,
Temple
University

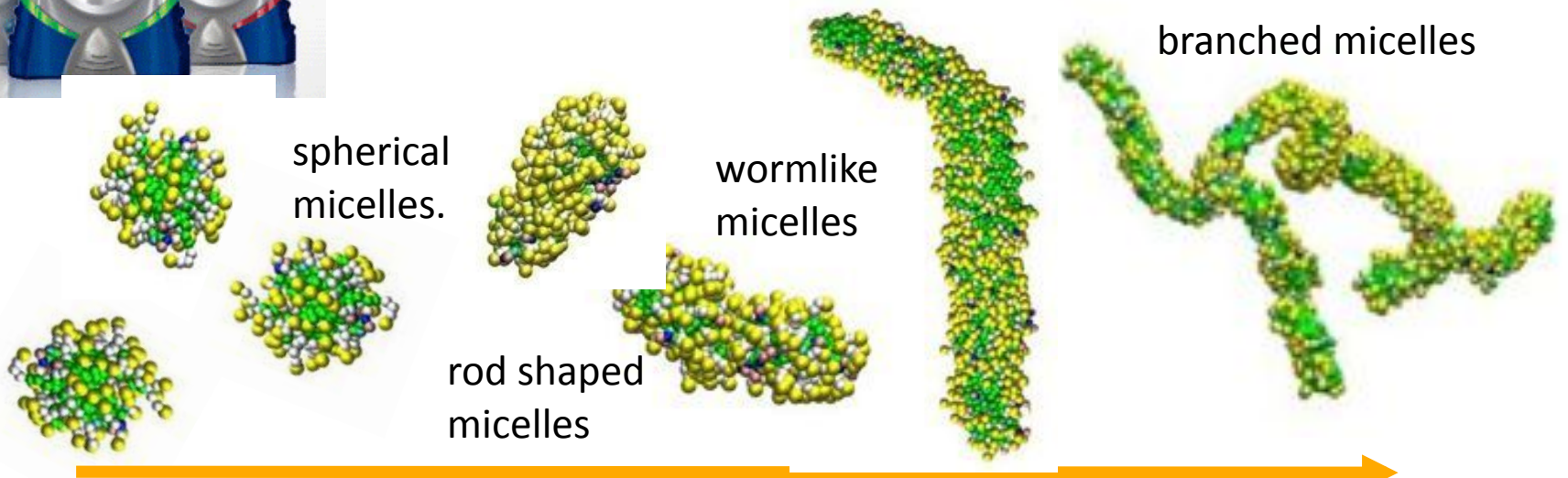
“Coarse Grained
Molecular
Dynamics
Studies of
Vesicle
Formation and
Fusion”



Understanding Body Wash Formulations – Micelles!



Why are some formulations thicker (e.g. rheology)
at *different* concentrations?



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

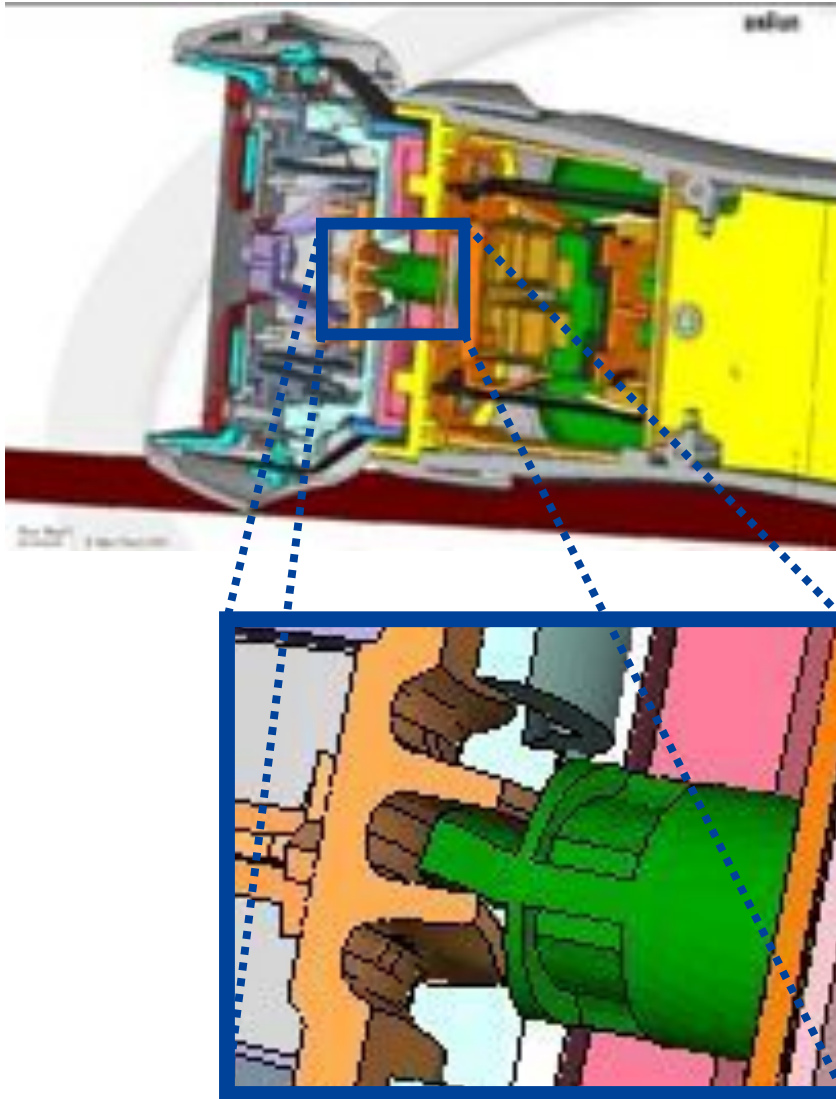




The new premium shaver ...



Bathroom Floor Drop



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

- **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





Mixing Non-Newtonian Fluids



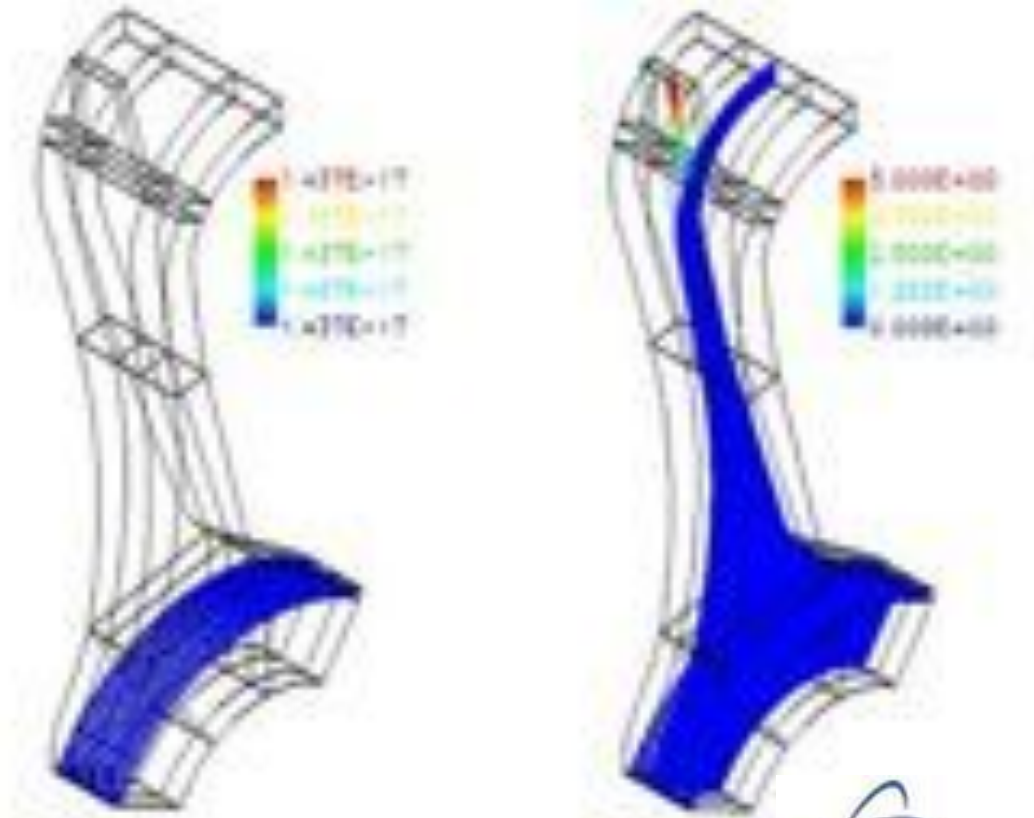


Fluids: Making Absorbent Diapers

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



Procter & Gamble © 2010



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

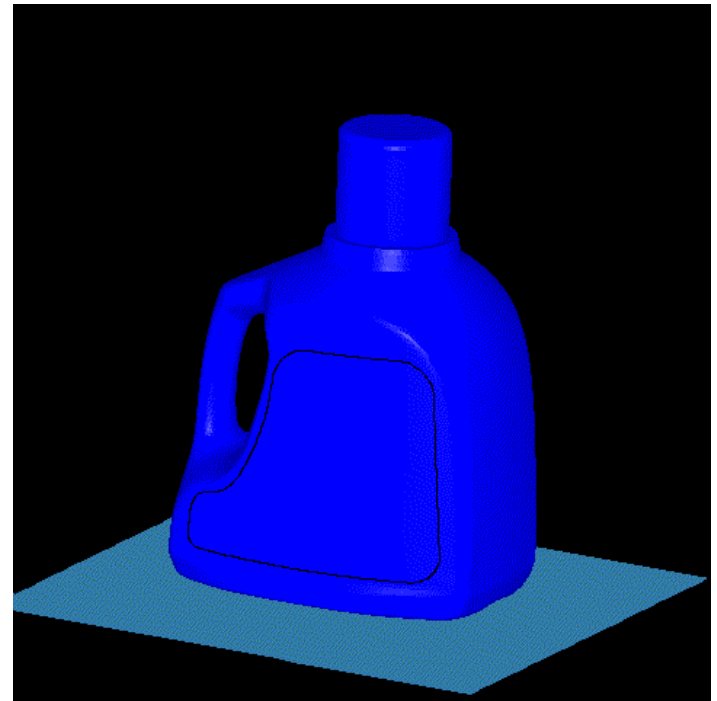


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Bottle Drop Simulation

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





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