Oak Ridge National Laboratory
Managed by UT-Battelle for the U.S. Department of Energy

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

Computational Engineering Modeling & Simulation

High Performance Computing for Engineering Simulation in the Transportation Industry

High Performance Computing Facilities

Eagle: 184-node IBM Winterhawk-II

- Four Power3-II processors per node
- 2GB memory per node.
- > 1 TeraFLOPs compute power.
- ORNL, Computer Science and Mathematics

Falcon: 64-node Compaq AlphaServer SC

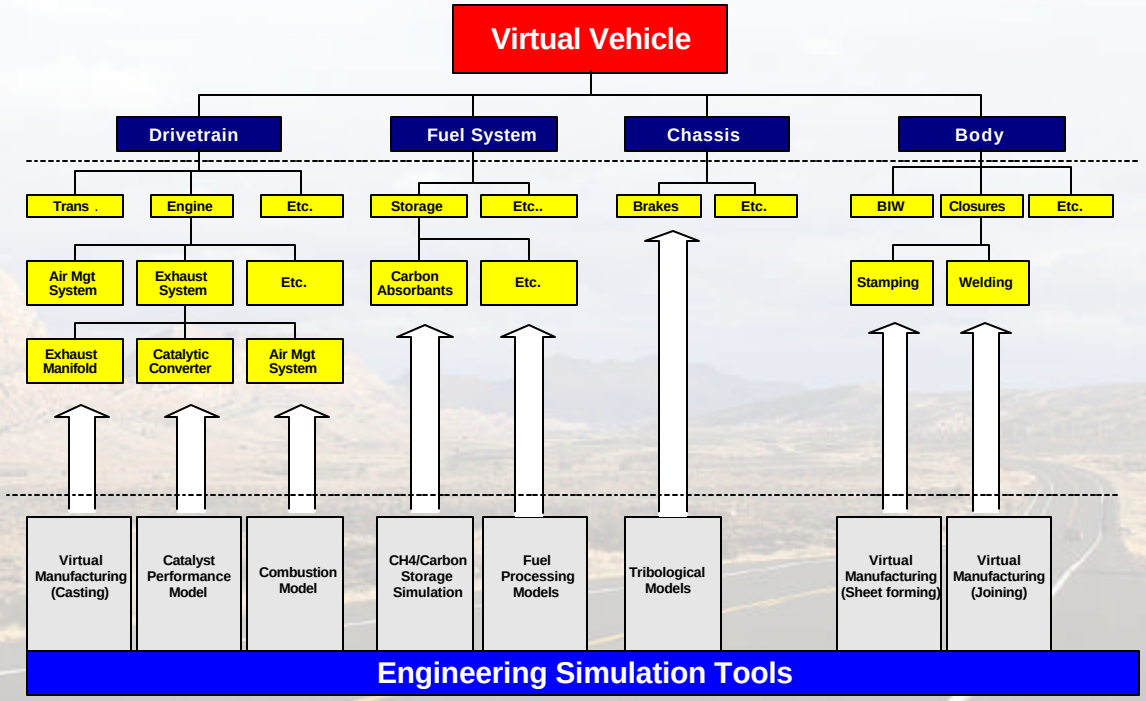
- Four Alpha EV67 processors per node
- 2GB memory per node.
- 2 TB of Fiber Channel disk attached.
- 342 GFLOPs compute power.
- ORNL, Computer Science and Mathematics

Jupiter: 26-node IBM Winderhawk-II

- Four Power3-II processors per node
- 3 GB memory per node.
- 156 GFLOPs compute power
- PNNL, Energy Science and Technology Division

Colony: 96-node Dell Giganet Linux Cluster

- Two Pentium III processors per node.
- 512 MB memory per node.
- 9 GB disk per node.
- PNNL, Molecular Science Computing Facility



Focus Areas

Manufacturing Processes

- Sheet metal forming
- Superplastic forming
- Tailored welded blank stamping
- Electromagnetic forming
- Tubular forming
- Superplastic forming
- Hydroforming
- Joining of sheet and tubular structures

Product Design and Performance

- Crashworthiness
- Stress analysis
- Aerodynamics
- Underhood thermal management

Emissions

- Catalysis
- Particulate formation

Fuel Cells

- Solid oxide fuel cells

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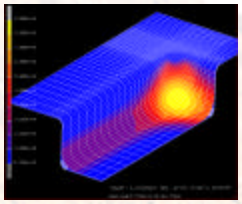
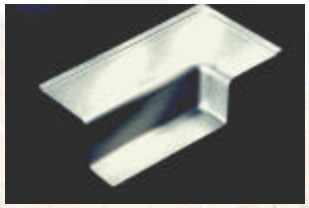
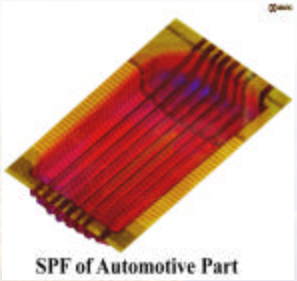
Metal Forming and Joining

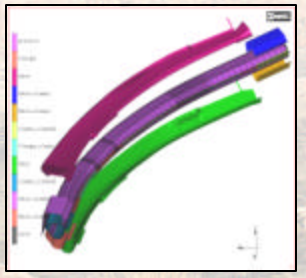
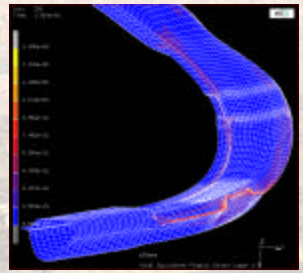
Superplastic Forming of Aluminum Sheet

2000 Winner of Federal Lab Consortium Award for Technology Transfer to Industry

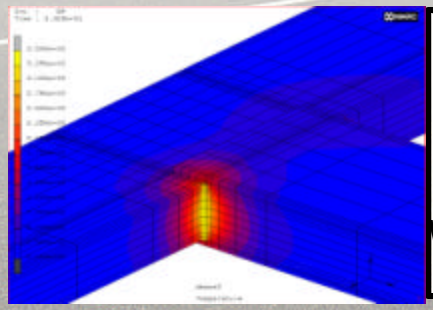




Process modeling and validation

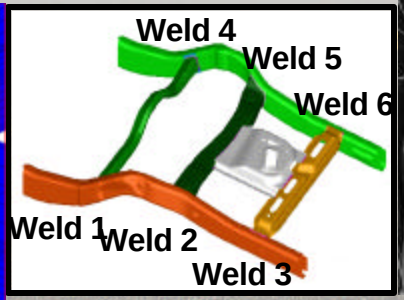
Hydroforming and Stretchbending of Aluminum Extrusions

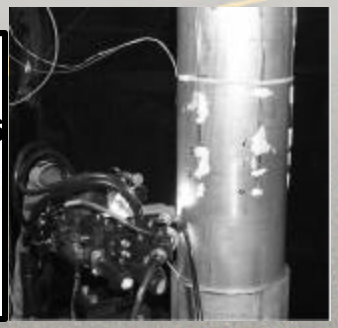
Modeling of Distortion in Large Welded Structures



Weld modeling

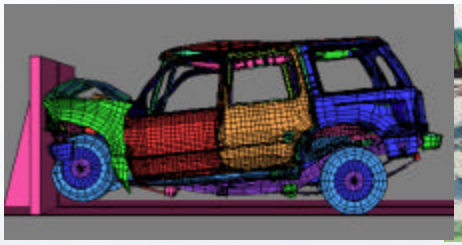


Weld design

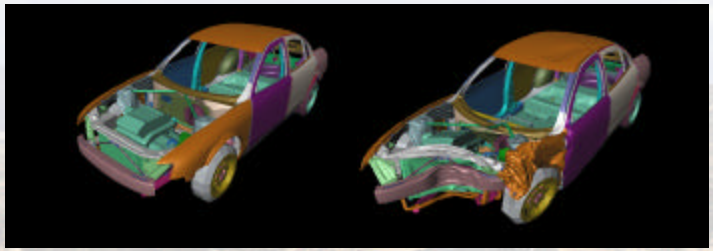


Welding experiments

Crashworthiness

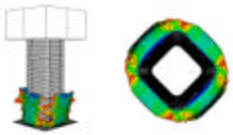


Crash modeling and testing of a sport utility vehicle

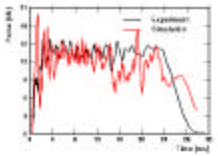


Crash modeling of an ultra-light steel automobile

Drop tower and crushed composite member



Finite element simulation of drop test performance



Accurate simulation of energy dissipation during impact

Testing and computer simulation of composite crashworthiness

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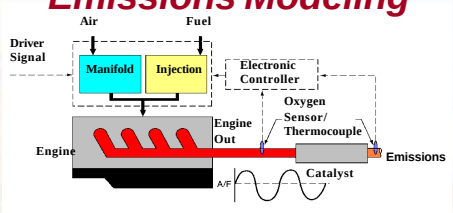
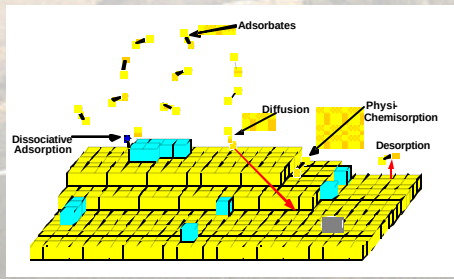
Emissions Modeling



Catalysis Simulation

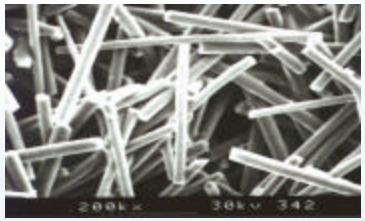
- Chemical kinetics
- Porous media flow
- Conduction heat transfer

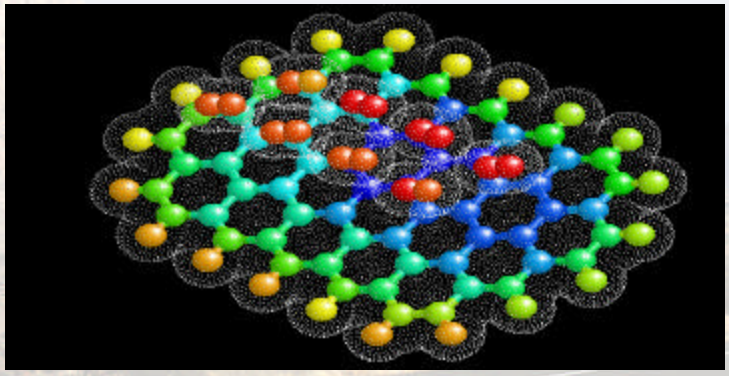


Computational Chemistry Modeling of Interfacial Phenomena

- Fuel cell electrochemistry
- Solar energy conversion
- High efficiency batteries

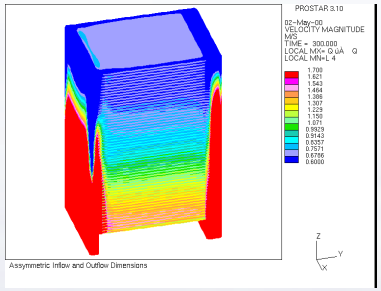
Fuel Storage Modeling



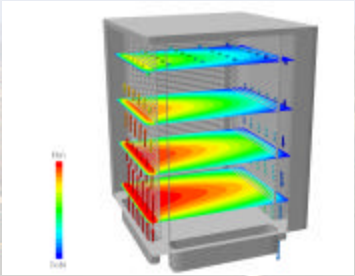


Atomistic simulation of methane and hydrogen storage materials such as graphite nanofibers, nano-tubes, and platelets.

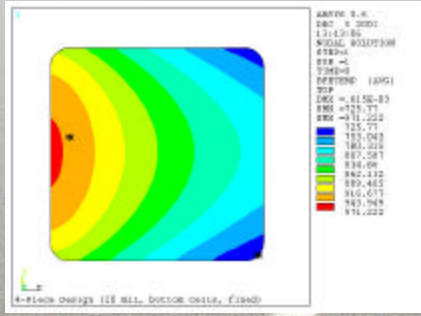
Fuel Cell Modeling

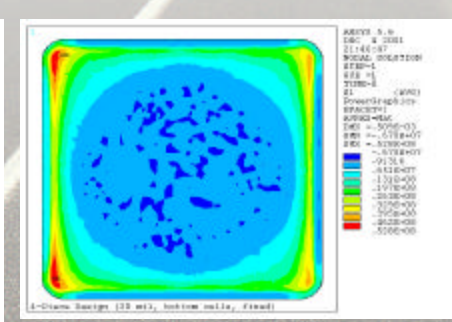


Flow in fuel cell stack



Temperatures in fuel cell stack





Temperatures and thermal stresses in fuel cell interlayer