Redefining the frontiers of computer simulation

prompt 2008-2010 Major Projects
Problems in today’s simulations

- Lack of integrated spatial data processing chain for interactive or real-time simulations
  - Modeling not closely coupled with simulation
- Emergence of Big data in simulations
- Critical memory & performance issues in:
  - modelling complete engineering systems
  - simulating large-scale and/or dynamical systems
- Geometric bottlenecks and inadequate computational models (algorithms) seriously hinder the evolution of computational scientific
Vision & Mission Statement

Breaking down techno barriers to accurately model, simulate and/or control real-world systems

- Leverage parallel architectures to meet the ‘Great Challenges’ of science and large-scale computations
- Provide a **unified and integrated data processing chain** for spatial information
- Apply **new mathematical methods and algorithms** to solve critical memory & performance issues for large-scale simulations
- Enable a new generation of dynamic/adaptative applications
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<tr>
<th>High-Performance Computing &amp; Simulation (HPCS)</th>
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<tr>
<td>simulation numérique</td>
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The Pain in the Market

• “Over the past few decades, advances in acquisition, modeling and simulation technologies have resulted in databases of 3D models that seem to be unlimited in size and complexity.”
  — David J. Kasik, Technical Fellow of the Boeing Company (Siggraph 2007)

• “We are drowning in data.”
  — Janette Wing, Assistant Director of the NSF (Business Week, Dec. 2007)

• “Simulating the world around us is becoming as important as wet experiments in everything from drug discovery to astrophysics, and high-power supercomputers will soon become a tool as essential as the microscope.”

• “Supercomputers require electrical power — a lots of it. That electrical power must come from somewhere, and it has a significant economic and environment cost.”
  — The HPC Brick Wall (Supercomputing, May 2007)

• “A clear trend in Engineering is towards complete system modelling… The computational power needed to cope with full aircraft simulation and optimization — from both an economical and ecological point of view — is $10^7 - 10^8$ higher than today’s capability.”
Simulation is a critical driver of scientific discovery and industrial innovation.
The Solution: New Algorithms & Hybrid Architectures

- « Issues and Challenges in Simulation-based Engineering Science (SBES) cannot be defeated simply by building bigger and faster computers. »

  — “Breaking through today’s memory and performance limitations”:
“Greatest Common Denominator” for Multiphysics, Multiscale Simulation

Integrated Computing System

Geometry

Graphics

Polynomials

Physics
Multiscale Modeling & Simulation

- CAD / CAM
- AEC
- CFD
- GIS
- Robotics
- Life Sciences
- Photogrammetry
- Data Acquisition
- Scientific Computing

- LLG Unification
- Space
- Airspace
- Ground infrastructures and Terrains
- Underground Maritime Undersea

- LLG Interoperability
- Markets
- Markets
Our objectives

- Enable Real-time interaction with Complex Models
- Unify Modeling, Simulation & Visualization through a common description for Geometry, Graphics and Physics
- Geometric calculation on any computing device
- Provide the 'missing link' for full interoperability and reuse of models and simulations
- High-performance computing (HPC) and simulation "in a box" ('co-simulators')
- Enable a new generation of dynamic/adaptative applications
  - Couple simulations and measurements in dynamic data-driven applications
  - Fill the interoperability gaps between simulation systems and other critical systems (command & control systems, embedded systems...)
Target Market Segments

- Aerospace
- Defense / Homeland Security
  - Fullfills defense and security historic needs to solve higher-level problems and optimization
- Advanced Transportation / Robotics
- GeoWeb
- Computational Science & Engineering
Projects of Interest in Homeland Security

- 3D Facial Recognition in crowded situation
- Robotic intervention in emergency situations
- Protection of critical infrastructures (ports, airports, subway stations, nuclear plants…)
- 3D City maps, including underground infrastructures… for first responders
- Wild Fires: Simulation and remote sensing
- 3D geographic information systems (GIS) for urban infrastructure management, homeland security
- Geometry/topology analyses… in N dimension (line of sight calculations, collision detection, design of homological sensor networks…)
- Representation of 3D solids in exact, non-polygonal geometry… for ballistic tests
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Thank you!