Argonne NATIONAL LABORATORY

TRANSIMS Studio and the RTE Run Time Environment

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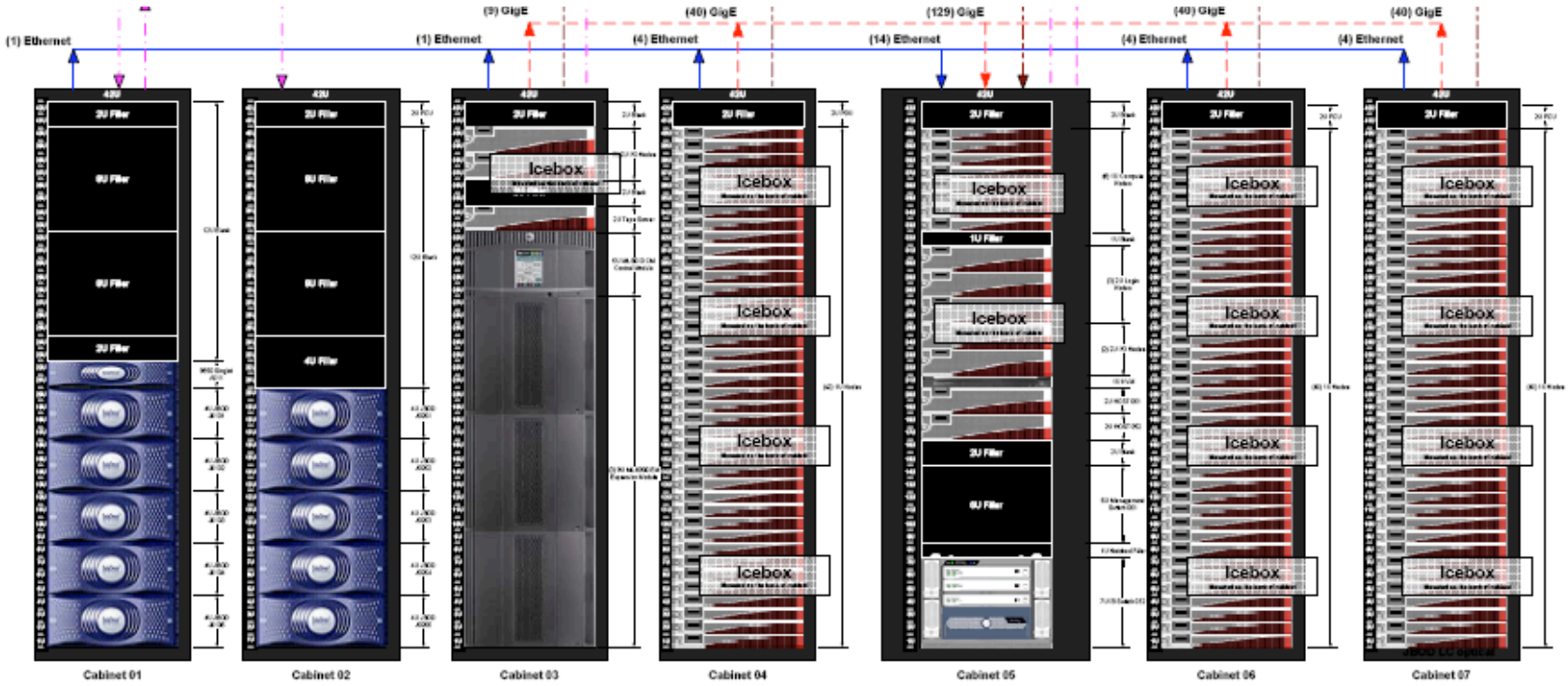
TRACC's Unique Role in the Development and Support of TRANSIMS

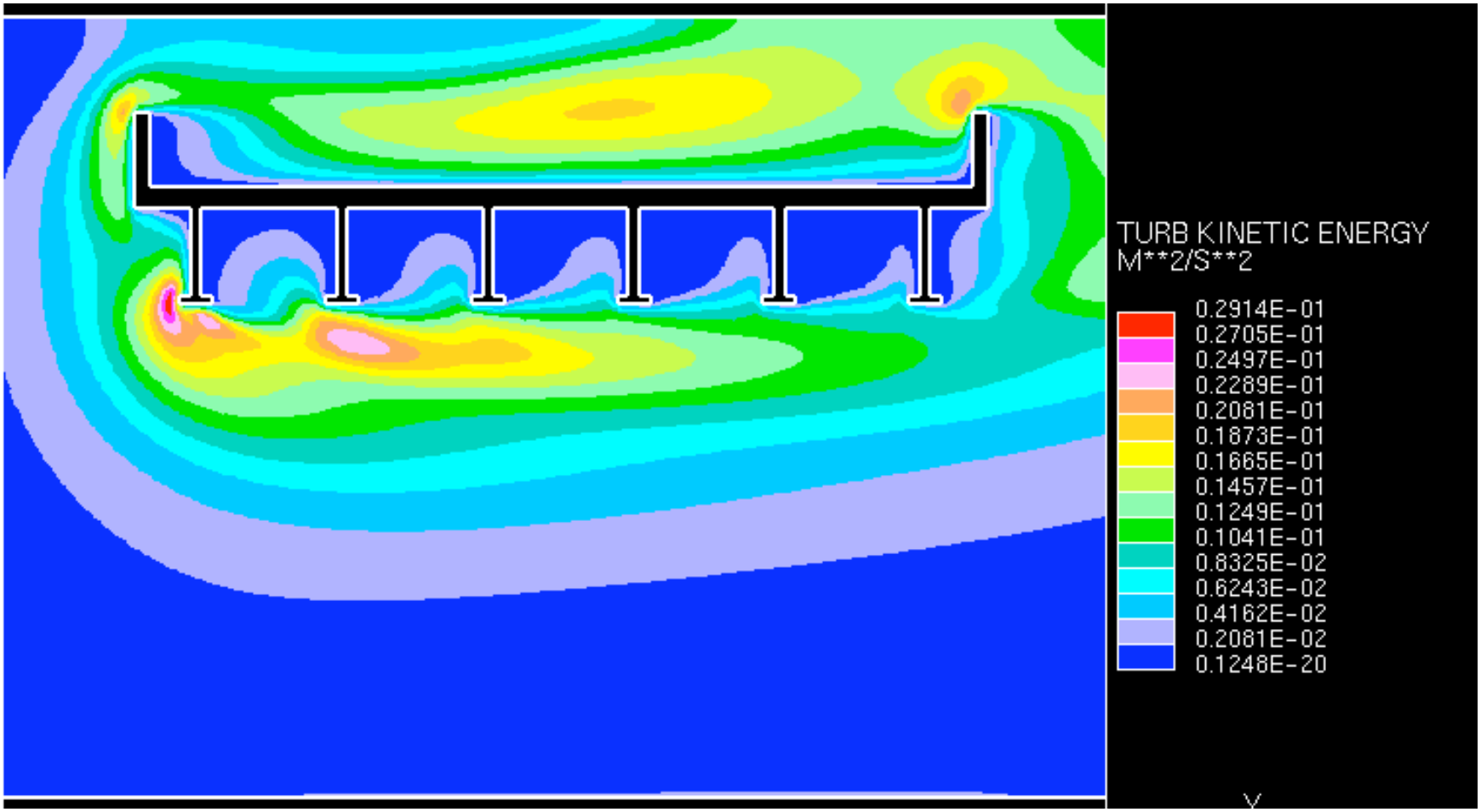
- USDOT and USDOE transportation research programs, private industry, and state and regional transportation agencies are moving to simulation-based design and analysis for improvements in efficiency, economics, and safety
- Higher fidelity analysis in areas such as crashworthiness, aerodynamics, combustion, thermal management, weather modeling, and traffic simulation require access to state-of-the-art computational and visualization facilities
- Argonne expertise in high-performance computing and transportation system analysis provides the basis for a national HPC user facility and a focal point for computational research for transportation applications
- TRACC's sponsor agency within USDOT is RITA (Research and Innovative Technologies Administration)
  - http://www.rita.dot.gov/

TRACC's Focus on High Performance Computing

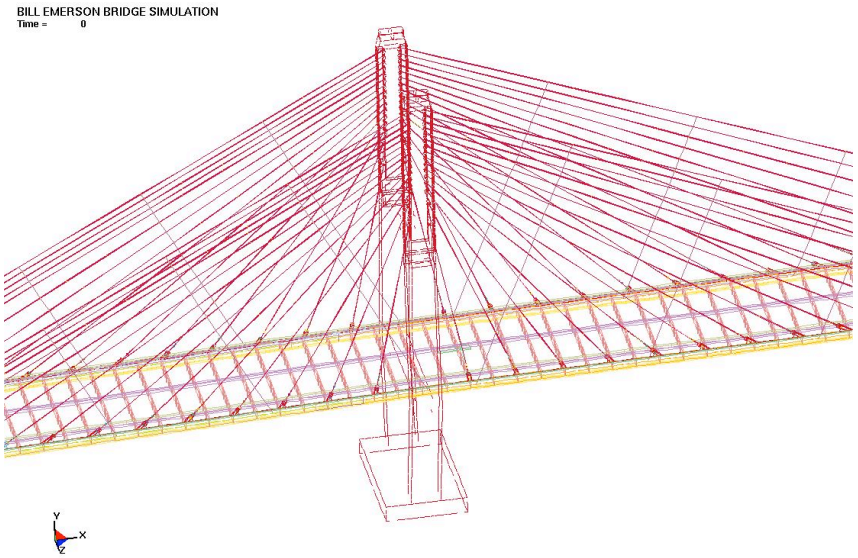
The TRACC computational cluster is a customized LS-1 system from Linux Networx consisting of 1024 core 128 compute nodes, each with two quad-core AMD Opteron CPUs and 8GB of RAM, a DataDirect Networks storage system consisting of 180TB of shared RAID storage, expandable to 750TB, a high-bandwidth, low-latency InfiniBand network for computations, and a high-bandwidth Gigabit Ethernet management network. The system also includes the highest-performance compiler and MPI library available for the AMD Opteron architecture. with a peak performance of ~4 TFlops.



Computational Fluid Dynamics

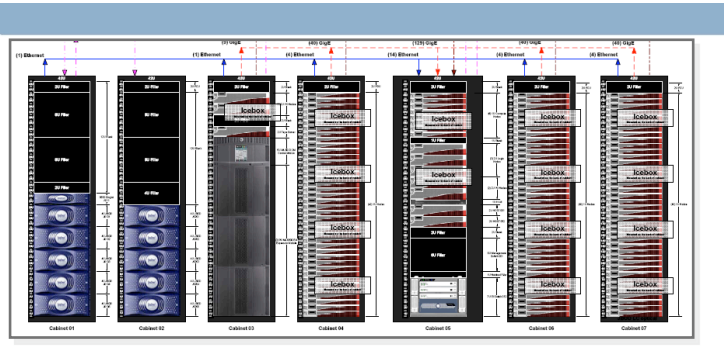


Computational Structural Mechanics



- To accurately determine the structural response of bridges to loadings from traffic, high winds, river currents and earthquakes, it is necessary to develop high fidelity numerical (finite element) models and perform transient dynamic analysis using state-of-the-art cluster computers
- The figure on the left shows the Bill Emerson Memorial Bridge that spans the Mississippi River between Illinois and Missouri near Cape Girardeau, Missouri; the figure on the right is a high fidelity model consisting of over 1,000,000 elements representing the important structural elements of the bridge

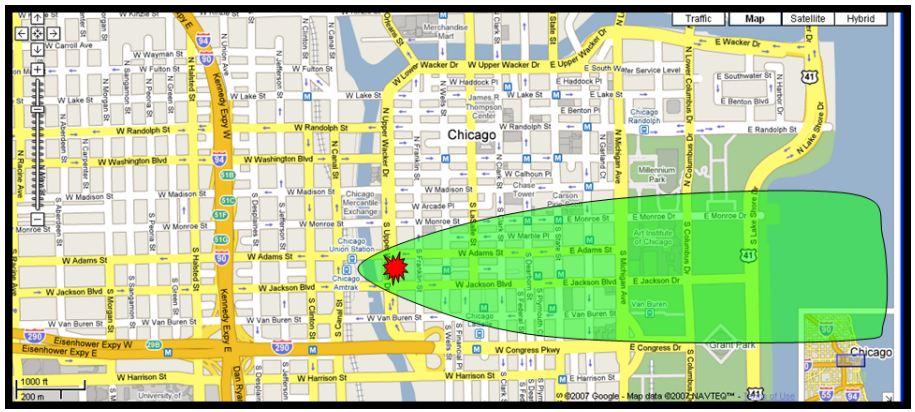
TRANSIMS User Support

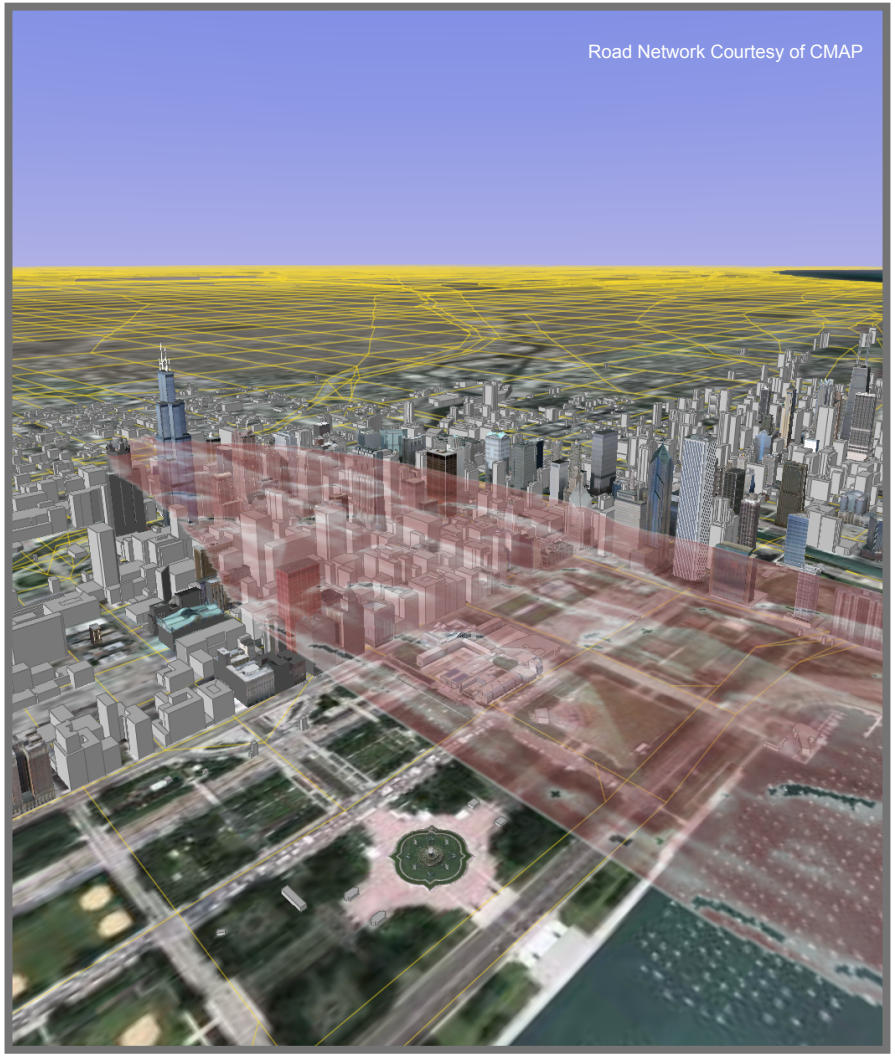


- TRACC is providing training courses on TRANSIMS to the transportation research community in the US
  - Training courses are offered approximately 4 times per year in varying locations
  - Participation is free, and training courses are broadcast over the Internet to reach additional users
- TRACC is holding additional training sessions on emerging capabilities through the Internet
- The goal is to build a strong community of expertise

Emergency Evacuations of the Chicago Business District

- TRANSIMS has unique capabilities to simulate the effects of emergency evacuations.
- This project has been implemented to model the effects of a no-notice event on the multi-modal regional transportation system in the Chicago metropolitan area.
- This project deals with the dynamic effect on the transportation system.
- Sponsored by the Illinois Terrorism Task Force, the Illinois Department of Transportation, the City of Chicago, and other federal, state and local agencies.





Reasoning and Concepts Behind the RTE and GUI

- TRANSIMS provides a very flexible set of tools that are ideal for research and development as well as integration with other software
- TRANSIMS lacks a larger execution framework that is flexible and extensible but provides a rigid framework for running complex jobs
  - Users write a combination of simple batch files and shell scripts
  - Everybody has reinvented some sort of template functionality
- While TRANSIMS executables are readily cross-platform compatible, any script driving a typical model is highly specific to the operating system and often even the underlying hardware
- None of the current approaches has an integrated help system or attempts to support the user with syntax checks and other development tools
- No tool exists that can provide intuitive click and point access to all data files, scripts, and control files
- Partitioning is difficult and not heavily utilized.
- Scripts and strategies become very complex to avoid unnecessarily rerunning some time-consuming tools

TRANSIMS / RTE

- The Run Time Environment has evolved from work on the Chicago Model as a library that makes writing TRANSIMS scripts significantly safer and more intuitive
- It is based on Python, and thus allows the user to have access to one of the best rapid prototyping environments available today
- RTE is based on Control Key Objects rather than control files
  - Objects can be loaded from files and string, and can be manipulated programmatically to support changes by iteration and other advanced scripting
  - Objects maintain state information so that they can automatically skip execution of a TRANSIMS tool if the input files are unchanged from a previous cached run
  - RTE watches closely over control key syntax and monitors in particular all file references, making it possible to rapidly run through complex iteration schemes in dry run mode
  - Partitioning is now trivial – by appending and extra parameter to the execution of an object, partitions are automatically spawned over available computing resources
  - Scripts are entirely system independent – e.g. scripts can be generically written for a certain maximum number of CPUs, but virtualization will maximize performance of the specific machine by queuing partitions on the available hardware

TRANSIMS / GUI

- The graphical user interface is another independent (but coordinated) part of TRANSIMS Studio. It provides the following features:
  - Platform independence: Windows, Linux, Mac (not fully supported at this time)
  - Built-In editors for script and data file editing
  - Built-In SVN support for source code control and model sharing between developers
  - Built-In Network Editor (optimized for high performance on large networks)
  - Built-In Help System (complete cross-referenced key and tool documentation)
  - Visual Studio IDE model, TRANSIMS runs within the GUI
  - Full integration with the job submission system on the TRACC cluster
  - Interaction with RTE to built a tree structure with automatic access to all input and output files for each tool, plus ctl and prn files, warning messages, and numerical results
  - The GUI is written itself in Python as well, but is being packaged as a standalone application with installers for Windows, and available from SourceForge
    - http://transimsstudio.sourceforge.net/
  - It was first posted on March 13, 2010, and has been (surprisingly) downloaded 150 times

Future Plans

- Full development of the Network Editor
- Full integration of TransVis into TRANSIMS Studio (visualization)
- Possible integration of Metropolis
- Editing capability for data tables (currently only viewing is supported)
- Tighter integration with TRANSIMS 4.2/5.0
- Running different tools concurrently
- API for user programs
- Control file editor with pull-down menus and knowledge of full control key syntax
- Regular training sessions on TRA NSIMS Studio for new and existing users
- Direct user support as part of the TRACC mission
- Extensive documentation of the code to make user-contributed functionality more likely

TRANSIMS Studio Screen Shot