Brief Introduction to Data-Driven Application Simulations

Craig C. Douglas
University of Kentucky and Yale University
http://www.mgnet.org/~douglas

Start with http://www.dddas.org

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What is DDDAS?

- It is a paradigm whereby application (or simulations) and measurements become a symbiotic feedback control system.
- Dynamically incorporates additional data into an executing application and lets an application dynamically steer the measurement process.
- Capabilities promise more accurate analysis and prediction, more precise controls, and more reliable outcomes.
What Benefits from DDDAS?

- Applications in business, engineering and scientific processes, analysis, and design.
- Areas in manufacturing process controls, resource management, weather and climate prediction, traffic management, systems engineering, civil engineering, geological exploration, social and behavioral modeling, cognitive measurement, and bio-sensing.
How Is DDDAS Done?

◆ **DDDAS** creates a rich set of new challenges for applications, algorithms, systems’ software, and measurement methods.

◆ **DDDAS** research typically requires
  – strong, systematic collaborations between applications domain researchers and mathematics, statistics, and computer sciences researchers
  – researchers involved in the design and implementation of measurement methods and instruments.

◆ Most DDDAS projects involve multidisciplinary teams of researchers.
A Few Samples

- Weather, climate, and ocean modeling
- Flooding, typhoons or hurricanes, thunderstorms, tornados
- Fires: wildland, forest, buildings
- Contaminants: transport (water/air), identification
- Oil/gas exploration
- Traffic flow: lights and vehicular behavior
- Terrorist attack follow ups
- Passenger screening at transportation centers (air/train/boat/bus)
- Manufacturing and full plant management
- Brain-machine interfaces
- Medical treatment (cancer treatment)
- High energy physics device control
- Mining safety would be nice
A Down to Earth Example: The Empty House DDDAS

- Sensors along driveway and near house
- Distinguish between animals, people, and vehicles
- Recognize regular delivery people
  - Possibly turn on lights
  - Greet them with prerecorded voices and messages
  - Direct receivables to box by door
  - Move contents of box indoors regularly
- Tell sales critters and religious nuts to go away
- Feed cats, put out garbage on correct days, etc.
- Give a complete lived in appearance to house
- Two way secure communication with residents