

Brief Introduction to Data-Driven Application Simulations

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<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***