Dancing the Good Fight

Multi-Resolution Modeling

UVa MRM Group
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MRM: It should be easy

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Ugrad talk
UNIFY: our first attempt

- Objective:
  - Modeling different representations (e.g., different levels of abstraction) of the same entity concurrently, while keeping the representations consistent

- Motivation:
  - Applications in modeling for socio-economic, biological, astro-physical, graphical, military domains…
A Recipe for MRM

- Construct an MRE from the representations of jointly-executing models.
- Capture dependencies among attributes with an ADG.
- Select mapping functions for each dependency.
- Classify interactions according to a taxonomy.
- Select policies for resolving the effects of concurrent interactions.
- Construct a CE and an IR for the MRE.
Guidelines for MRM

- **G1:** Represent entities at levels at which they can interact.
- **G2:** Maintain concurrent representations for jointly-executing models.
- **G3:** Make time-steps of multiple models compatible.
- **G4:** Capture cross-model relationships.
- **G5:** Propagate the effects of an interaction to all representation levels.
- **G6:** Select mapping functions for each relationship between representations.
- **G7:** Identify semantic characteristics of interactions.
- **G8:** Select policies for resolving the effects of dependent concurrent interactions.
UNIFY: our first attempt

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Current Thoughts

Objective:

- Modeling different phenomena (possibly different levels of abstraction of the same phenomena) concurrently, while meeting user requirements.

  » Internal consistency is secondary to user requirements
  » Should require less developer and user effort
Dancing the Good Fight

- Exploring application of *space-time constraints* (STC) to MRM of Military Operations in Urban Terrain.
  - STC currently applied in graphics animation (Coke cans scripted by ballerinas!)
  - We expect its underlying technology be applicable to requirements capture for MRM.
Dancing: The Goal

Z: A simulation having the execution efficiency of X with the potential for capturing the detail of Y.
   e.g. X is a special operations force sim
   Y is a highly detailed individual soldier sim
   Z is X with proper reflection of Y’s detail
Dancing: Applications
(unlimited)

- Macroeconomic model reflecting detailed stock market activity.
- Atmospheric model reflecting tree canopy CO$_2$ uptake models.
- Aircraft carrier maintenance models reflecting detailed sortie activity.
- Network congestion models reflecting localized communication
- And of course, MOUT
Dancing: The Basic Idea

- Essential behaviors of X and Y models are identified through a CAPTURE process associated with exercising and observing the models.
  - Critical behaviors become model constraints.
- Meta-constraints (constraints outside of model behavior) are identified.
- Z is constructed from X plus model and meta constraints.
- Z is exercised in a dynamic (constraint capturing) editor under different scenarios by a subject matter expert.
- A robust Z emerges.
Basic Idea Redux

Capture X constraints

Capture Y constraints

Capture meta constraints

Model X

Z

Scenarios

Dynamic editing

Robust Z
Critical Components

- Model CAPTURE process --exercise and observe models.
  - Critical behaviors become model constraints.
- Meta-constraints CAPTURE --constraints outside of model behavior are identified.
- Constraint representation.
- Constraint incorporation process (into Z)
- STC engine
- Dynamic (constraint capturing) editor – for capturing different scenarios by a subject matter expert.

Challenge in keeping separate
Want to get Involved?

- Reverse engineer existing programs given to us by our sponsor.
- Explore visualization tools for extracting/viewing program information.
- Learn about space time constraints and solve how to separate its implementation from the programs for which we’re doing MRM.
- Build editing tools for incorporating user-specified constraints into existing program.
- ...
Away We Go!

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