DATA DRIVEN ASPECTS OF AN ARCHITECTURE FOR A MULTIPHYSICS APPLICATIONS ENVIRONMENT

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We present the design architecture of a multidisciplinary problem-solving environment (MPSE) for supporting an efficient prediction capability for the response of interdisciplinary continuous interacting systems.

This design takes into consideration information technologies, coupled multiphysics sciences, and data-driven characteristics to steer adaptive modeling and simulation of the underlying systemic behavior that corresponds to multiphysics systems. The implementation of this architecture constitutes a data driven environment for multiphysics applications (DDEMA).

The data-driven character of DDEMA is defined in terms of prior and real time modalities requirements. Under the prior time modality data will be gathered (or simulated) from systematically scanning the state space of material systems to be identified through the use of a custom-built multidimensional robotic loading machine. This mechatronic system will be an extension of a currently existing 6-dimensional loader to include additional fields such as temperature and humidity that coincide with mechanical loading. In addition, generation and numerical solution of constitutive and field evolution equations will be automated. Such equations will be applied to describe behavior of interacting continua such as those of aero-hygro-thermo-structural systems from the fluid-structure interaction under multifield loading conditions. These activities will maximize confidence for the accuracy of the simulated predictions and will introduce the multiphysics character of DDEMA in the prior-time context. The application chosen for validation of this scenario is material/structure design of supersonic platforms. Under the real time modality data will be gathered form sensor networks that will that will be used to either facilitate appropriate model selection and identification or injected on simulations to steer them and adjust them to reflect current time situations. A validation application of the real time modality of DDEMA will be for the case of fire/material/environment interaction monitoring, assessment and management

Special emphasis will be given on the utilization of contemporary information technologies, including actor-agent based middleware for integrating all scientific methodologies into a simulation-based computational environment that enables domain experts to answer practical “what-if “ questions and address specific design and system response qualification issues.

Acknowledgement
The authors acknowledge the support by the National Science Foundation under grant EIA-0205663.