MSM Abstract

Eight reasons why relational grounding facilitates developing scientifically useful multiscale models

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A multiscale modeling and simulation research goal is discovering and validating causal linkages in both normal and pathologic settings, and using that knowledge to better understand interindividual variability in response current therapeutic interventions, and to discover new treatments. Achieving those goals requires mechanistic and uncertainty representations within software constructs capable of evolving and accommodating concurrently to accommodate new knowledge. Such change cannot be achieved smoothly and easily without prior consideration of model grounding issues at all model development stages. In this poster we provide examples in support of that statement. Most mechanistically focused, multiscale models are conflations of at least two models, descriptions of possible or plausible mechanistic features and a quantitative model-to-referent mapping model. There are advantages to separating them. Groundings are the collection of units, dimensions, and/or objects to which a variable or model constituent refers. Absolute grounding uses real-world units; metric grounding uses subsets of metric spaces; hyperspatial grounding uses a composite of multiple metric spaces and possibly non-spatial sets; and relational grounding uses units defined by other system components. Examples will illustrate eight reasons why relational grounding facilitates development of scientifically useful multiscale models. 1) Biology uses relational grounding. 2) Absolute grounding complicates the process of combining models to form larger models unless all are grounded absolutely. 3) Relational grounding facilitates referent knowledge embodiment within computational mechanisms but requires separate model-to-referent mapping models. 4) Relational grounding enables synthesis of large, composite (multi-module) models that can be robust to context changes. 5) Biomimetic components in MSMs need to have varying degrees of autonomy. Relational grounding facilitates achieving such autonomy. 6) Exploring mechanisms of normal-to-disease transition requires model components that are grounded relationally. 7) Grounding decisions influence model flexibility, adaptability, reusability, and ability to validate against sets of multi-source, diverse data. 8) Grounding decisions should be influenced by measures, uncertainty, system information, and the nature of available validation data. We maintain that grounding issues should be addressed at the start of any MSM project and should be reevaluated throughout the model development process. We also maintain that use of relational grounding will provide the flexibility required to individualize envisioned, multiscale patient models.