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EXPLORING DSM TO SUPPORT SYSTEMS ENGINEERING OF COMPOSABLE SIMULATION ENVIRONMENTS

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Keywords: design structure matrix, multiple domain matrix, complexity management, composability, interoperability, modeling & simulation, systems engineering, fidelity, verification & validation

1 INTRODUCTION

A critical distinction between *distributed computing* in general and *distributed simulation* specifically is rooted in that simulation systems are meta-systems such that their underlying models are essentially complex, multi-disciplinary *systems-within-systems* [13]. A *simulation environment* refers to the software and hardware facilities that are integrated and configured in order to generate a set of simulated conditions for analysis, testing, and/or training. As such, *systems engineering* (SE) directed at *modeling & simulation* (M&S) must deal with complexity that extends beyond the more objective operational infrastructure of *simulation environments* to the reconciliation of more subjective multi-disciplinary syntactic and semantic concerns associated with their underlying constituent models. Some model complexity initiatives have emerged in the simulation community including a significant *simulation-composability* movement. This has been largely directed at the reuse of existing models and other simulation-oriented assets for the expeditious and economical assembly of valid simulation environments addressing multiple uses. But simulation composability has proven to be one of the most difficult challenges in the M&S frontier. Even the most experienced practitioners in this area of simulation research dismiss the illusion of pure *plug-and-play* composability – calling instead for the elaboration of more realistic M&S SE methods that address simulation complexity so as to minimize the composition time and level of effort in simulation-environment design and development [14]. Intuitively, an effective M&S SE approach should consider a framework that facilitates the reconciliation of such fundamental concepts as fidelity, composability, and validation; these and other familiar concepts have not been standardized in the simulation community leading to some level of syntactic and semantic disconnect among M&S practitioners and other stakeholders that exacerbates the complexity of simulation projects. Simulation fidelity, in particular, has been the source of much debate and even controversy yet it holds the potential to resolve complexity as it is a key multi-dimensional concept that characterizes and influences the conceptualization, specification, design, and development of simulation environments. The *Multiple Domain Matrix* (MDM) derivative of the *Design Structure Matrix* (DSM) method has been employed successfully to analyze and manage cross-domain complexities in product development, manufacturing, construction, process control, software design, and various other engineering settings. This paper presents an initial approach that attempts to leverage the MDM as a framework for the management of complex simulation fidelity dimensions as an enabler of composable simulation environments.

2 BACKGROUND

2.1 Multi-perspectivity in simulation

The multi-disciplinary nature of the M&S and SE disciplines introduces significant inter-disciplinary disparities in terminology, concepts, propositions, evidence, assumptions, boundaries, and other aspects of simulation-based acquisition and support. This *multi-perspectivity* phenomenon [1] is often overlooked or disregarded even though it introduces non-trivial complications that severely undermine the planning, quality, and productivity of M&S projects. It cannot be over-emphasized that multi-perspectivity is a significant contributor of complexity in simulation projects when syntactic and semantic disconnects occur among M&S practitioners and stakeholders.

The multi-perspectivity problem is best summarized in the Buddhist parable of *The Blind Men and The Elephant* in which a group of blind men (unfamiliar with elephants) attempt to describe an elephant by each touching a different part, and only one part (e.g., leg, tusk, ear, tail, etc.). Upon comparing their individual experiences they come to complete disagreement – and discord.

There is ample evidence in the literature that multi-perspectivity is symptomatic in the M&S and SE communities and that the many connotations of fidelity, composability, validity, and other concepts inhibit progress in M&S formalisms and standards [3–6].

M&S projects that involve multiple laboratories or centers are particularly vulnerable to the multi-perspectivity problem due to the sheer number of researchers from various backgrounds and experiences working independently prior to joining a collaborative effort.

2.2 Systems engineering and the simulation problem domain

SE in general is arguably concerned with reconciling the multi-perspectivity between technical and management concerns; management processes organize the technical efforts while technical processes address information assessments, performance measures, trade-off analyses, build and test planning, and other technical aspects of a project.

M&S SE in particular is arguably extended to the more intricate *simulation problem domain* which involves not only the more apparent operational and support infrastructure of simulation environments but also the nested problem domains (i.e., *systems-within-systems*) that are increasingly directed to address the multiple problem domains of complex *systems-of-systems* (SoS).

A computer simulation model is distinguished from a generic computer program in that the core purpose of a model is to represent a *simuland* [2]. A simuland refers to a natural or man-made system being simulated by a simulation [13] whereas a *referent* refers to the sum total of what is known, assumed, or projected about a simuland.

Previous work has studied simulation composability and reusability by defining the *context of models* as experimental frames under which a model is valid [11, 12]. That work studied the complexity of capturing validation constraints and found that different groups have a tendency to produce divergent lists of orthogonal constraints [11] – underscoring the multi-perspectivity problem and suggesting that the specification of a simulation environment solution should be deliberately focused on a particular problem space rather than driven by product advocates or vendors.

An alternative approach is offered here in which context is more focused on the problem space rather than on models. In this manner, the burden of defining the context and validation basis of a proposed simulation environment solution is placed on the owner of the problem space rather than on the owners of models who are likely to have a model-biased perspective of what the composition of the simulation environment solution should be.

A first-order decomposition of the simulation problem domain would include 1) reflecting, capturing, or responding-to the context of a real world problem (i.e., putting the real-world problem domain in context), and 2) deriving the scope of a corresponding simulation environment solution consisting of two sub-domain partitions: the *referent domain* and the *infrastructure domain*.

The referent domain is concerned with all the models that capture the appropriate body of knowledge about the relevant simulands and bound the scope of a contemplated simulation-based experiment. The infrastructure domain is concerned with all other operational and support functionalities that are needed in order to realize, operate, and interact-with the simulation environment. That is, the referent domain addresses "what" phenomena need to be considered for experimentation whereas the infrastructure domain addresses "how" a simulation environment solution will be realized in order to carry out the experimental needs.

Although the referent and infrastructure domains are two principal and critical areas of concern in M&S SE that address and define the context and scope of a simulation project, the initial approach presented in this paper is contained to the referent domain.

2.3 Fidelity and validation & verification

Fidelity is the proverbial and controversial "elephant in the room" that the simulation community has wrestled-with for a long time and that prefers to deal with in an informal basis even though it is regarded as the key to simulation validation [3]. Fidelity is closely related to *validation & verification* (V&V), yet their correlation is seldom formally or objectively specified in simulation projects largely due to the many fidelity connotations.

In addition to its technical implications, increases in M&S fidelity generally translate into increases in cost and schedule. Therefore, specifying the appropriate fidelity is a critical M&S SE risk area such that circumventing it or leaving it to chance or improvisation is very unwise although frequently done.

Fidelity is unique to each application of a model or simulation and it should be described in terms of an appropriate subset of attributes, characteristics, and/or behaviors derived from a referent baseline and directed by a set of *specific intended uses* (SIUs). For this reason, connotations of "high fidelity" and "low fidelity" are not very useful for specific M&S SE purposes and are best relegated to non-technical uses.

The SIU term is a bit of a misnomer in and of itself. It has contributed to the multi-perspectivity problem as it is often confused with story-boarding or sequence of usage. Instead, an SIU refers to a declaration of purpose akin to a hypothesis statement in that it presents a question of interest and/or a decision-support information need for which simulation-based experimentation is a desirable, affordable, or otherwise available alternative. As such, SIUs establish the context or *validation basis* of a proposed simulation environment solution.

It cannot be over-emphasized that validation is central to simulation endeavor. It refers to a process for determining that *the right simulation environment solution was conceptualized (and built)*. What makes the "right" simulation environment applies to all of the simulation environment components. In the referent domain, specifically, what makes the "right" model translates to selecting the appropriate fidelity of the model, which amounts to the process of ensuring that the model possesses or is projected to possess the appropriate breadth and depth subset of attributes, characteristics, and/or behaviors from a referent baseline. In the absence of established fidelity guidelines, this process tends to be conducted by subject-matter-experts (SME), which may introduce technology-centric or model-centric biases and subjectivity, a potential multi-perspectivity problem area.

In contrast to validation, verification is a process concerned with confirming that *the simulation environment solution was built right*. This refers largely to ensuring that the design and construction of the simulation environment satisfies the scope prescribed in the requirement specifications derived from the SIUs. In the referent domain, this amounts to ensuring that the specified algorithms, initial and boundary conditions, assumptions, linearities/non-linearities, and other aspects of functional representations of systems or phenomena are properly codified into models; and that an implementation of a model (into a simulator) leads to simulated results that are consistent with a postulated range of outcomes established in or extrapolated from a corresponding referent. This process also tends to be subjective and designated to SMEs due largely to a lack of fidelity-oriented model verification benchmarks, yet another potential multi-perspectivity problem area.

The subjectivity employed in model V&V offers a glimpse into the *problem of induction* that occurs in the simulation community and that manifests itself most often as black-box "validation by verification." This is the practice of subjective validation of models through the verification of simulation performance in which generalizations about the properties of a model are based on some number of observations of particular executions of the model rather than validation based on the intrinsic properties coded into the model and cross-checked against a set of contextual SIUs.

2.4 Composability

Composability refers to the capability to select and assemble simulation components in various combinations into valid simulation systems that satisfy specific user requirements [6]. Any set of components can be integrated and configured into a valid simulation environment given enough time and resources; composability implies a certain readiness of a set of components to be assembled into a valid simulation environment in a timely and reliable manner [6].

This is a particularly important distinction in that the usefulness of a simulation environment depends largely on its responsiveness to emergent challenges that more often than not require decision support information sooner rather than later. Composability therefore implies not only improved economics in reusability but also more versatile, expeditious, and robust responsiveness.

Composability also differs from interoperability in that it is concerned with ensuring that a combination of models can communicate in a meaningful way; in contrast, interoperability is concerned with data exchange at run-time, thus ensuring that the protocol is used correctly and that the data exchange occurs according to model specifications. Interoperability is essential to achieve composability, but interoperability alone is not sufficient to achieve composability. It is convenient to think that composability operates at the modeling (referent domain) level whereas interoperability operates at the simulation application (infrastructure domain) level [6].

Composability is decomposed to address the semantic and syntactic aspects of models. The notion behind syntactic composability is whether or not models can be connected such that their implementation details (e.g., prototypes, data structures and access, parameter passing, timing assumptions, etc.) are compatible for all possible configurations. Semantic composability, on the other hand, involves ensuring that the computations among combined models are semantically valid [6]. Note that two or more models may exchange data syntactically and yet be semantically incompatible. Also, two or more valid models (i.e., two or more models validated for different SIUs) may produce invalid results when combined to address an SIU beyond the SIUs for which the models were originally designed.

The proposition is that there exists a coupling among SIUs, fidelity, and V&V that extends to composability, such that, for a set of purported reusable simulation assets to be deemed composable, a certain correspondence of their intrinsic properties must exist. This correspondence is expressed in terms of model fidelity, in order for a valid composite simulation environment to produce verifiable results that are useful in that they satisfy a prescribed set of SIUs.

3 MDM AS ENABLER OF FIDELITY-BASED COMPOSABILITY

In general, arbitrary sets of referent characteristics are coded into models. These characteristics are system properties which could be liberally defined as "sets of phenomena" that amount to observable things, facts, or events of interest. These would include fundamental notions such as time, space, mass, energy, etc. from which more elaborate notions can be elaborated such as velocity, density, power, etc.

From this perspective, one can define the set U to denote all universal phenomena and the set R to be a subset of U that denotes all phenomena that are known ($i.e.,$ the total of all available referents; $R = R_1 \cup R_2 \cup \ldots \cup R_n$). The universal set U would then be the union of all phenomena that are known and all phenomena that are not known ($U = R \cup R^c$). For instance, R_1 could represent all that is known about ship hulls, R_2 could represent all that is known about calm and shallow water hydrodynamics, R_3 could represent all that is known about ship navigation, etc.

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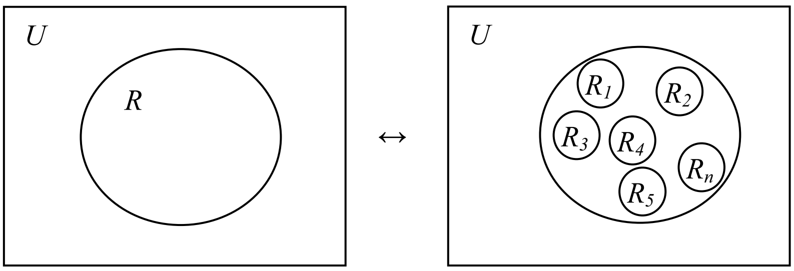


$$U \stackrel{\text{def}}{=} universal\ set\ of\ phenomena = R \cup R^c$$
$$R \stackrel{\text{def}}{=} set\ of\ total\ known\ phenomena\ (i.e., all\ referents) = R_1 \cup R_2 \cup \ldots \cup R_n$$

Figure 1. Universal phenomena vs. phenomena referents

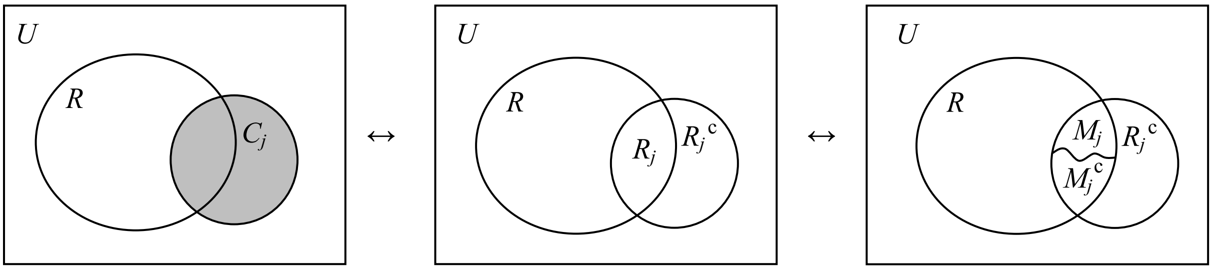
A proposed simulation environment solution is driven by a set of SIUs which amounts to the proposition of expanding the body of knowledge of a particular referent or set of referents. As such, one can define C_j to be a subset of U that bounds the phenomena of interest associated with the context of an SIU problem space and that would correspond to a proposed but undefined simulation environment solution.

Such a set $C_j = R_j \cup R_j^c$ would consist of the union of subsets R_j (that denote the known phenomena of interest) and its relative complements set R_j^c (that denote the imagined, projected, or postulated phenomena associated with a set of SIUs; i.e., the set of phenomena information sought). For instance, R_j could refer to the phenomena associated with ship hull performance under navigation conditions in calm and shallow water, and R_j^c to the set of phenomena needed to make architectural decisions about ship hull design projected to navigate in deep waters (assuming that no referent exists for these phenomena).

The *required fidelity* of a prescribed set of SIUs is then the scope (of the referent domain) of a proposed simulation environment solution and would include the range, precision, and accuracy of each of the elements of the phenomena identified in a set C_j.

The set R_j would consist of all phenomena encapsulated by a particular referent or set of referents and it would be partitioned into two sets: the set M_j that denotes the phenomena which has been coded into models and its relative complement set M_j^c that denotes all phenomena from the same particular referent or set of referents which has not been coded into models.

The *available fidelity* would then include the range, precision, and accuracy of each of the elements of the phenomena identified in set M_j which is encoded into models.



$$C_j \stackrel{\text{def}}{=} set\ of\ phenomena\ of\ interest\ that\ depicts\ SIU\ context$$
$$R_j \stackrel{\text{def}}{=} set\ of\ SIU\text{-}aligned\ phenomena\ encapsulated\ by\ particular\ referent(s)$$
$$R_j^c \stackrel{\text{def}}{=} set\ of\ SIU\text{-}aligned\ phenomena\ that\ expands\ referent(s)$$
$$M_j \stackrel{\text{def}}{=} set\ of\ SIU\text{-}aligned\ phenomena\ from\ referent\ coded\ into\ models$$
$$M_j^c \stackrel{\text{def}}{=} set\ of\ SIU\text{-}aligned\ phenomena\ from\ referent\ not\ coded\ into\ models$$

Figure 2. Phenomena set partitions of referent domain

The set R_j^c would consist of phenomena that may be derived from existing referents or it may be phenomena that are postulated. In either case, these are phenomena that have yet to be coded into models. This *emergent fidelity* would include the range, precision, and accuracy of the elements of the phenomena set R_j^c that would expand the referent and provide the decision-support information sought.

A valid simulation environment would be one in which the available and emergent fidelity satisfies the required fidelity. That is, the models underlying a proposed simulation environment solution would be deemed to be "the right models" if their intrinsic properties match the context of the SIU problem space.

Verification of the simulation environment, on the other hand, would then be achieved by analyzing the output elements of the phenomena sets M_j, M_j^c, and R_j^c after simulation execution and confirming that their generated values fall within tolerances of expected values. That is, the models underlying the simulation environment would be deemed "to have been built right" if it they are valid and if they produce results consistent with referent benchmarks or expectations.

These partitions of the set of phenomena would serve as DSM domains as illustrated by the rudimentary MDM in Figure 3. The shaded DSMs correspond to the phenomena context that is established or directed by the SIU problem space. In general, the phenomena context of a problem space would be properly bounded when an exhaustive correspondence between the elements of the SIU DSM (i.e., the decision support information needed) and the C_j DSM (i.e., the phenomena context necessary to provide the information needed) is established. And it follows that a proposed simulation environment solution would be valid when an exhaustive correspondence of the elements of the C_j DSM is established with some combination of the elements of the M_j, M^c_j, and R^c_j DSMs (which may or may not be exhaustive).

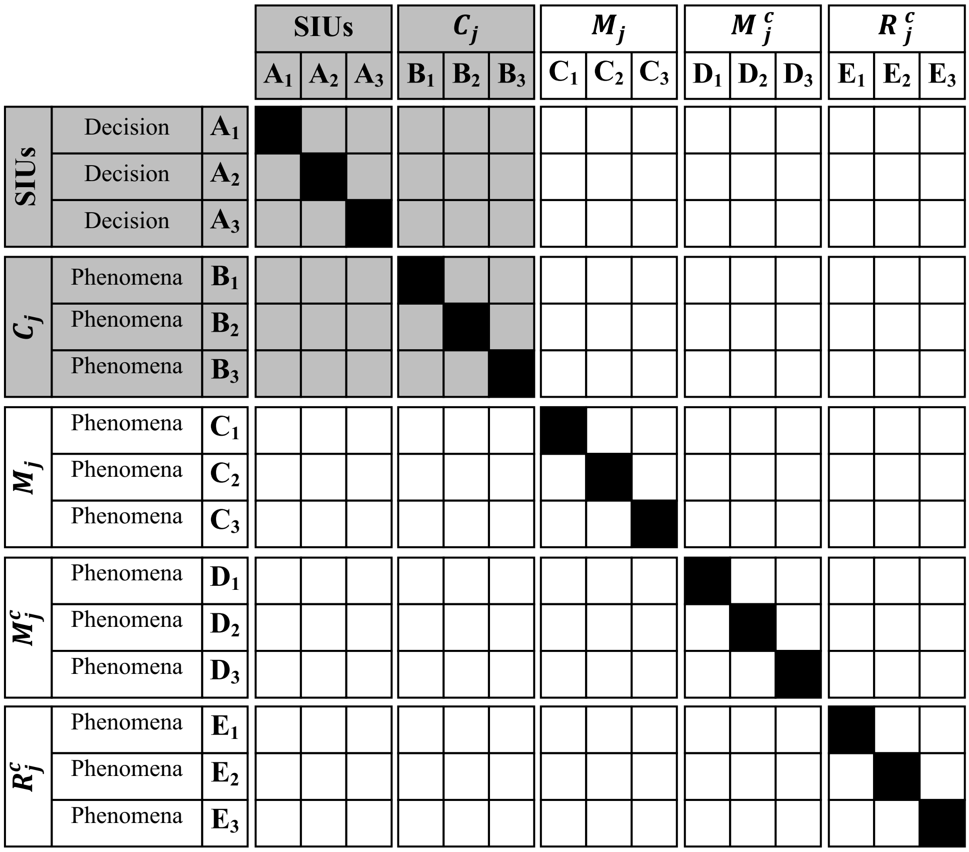


Figure 3. MDM domains corresponding to phenomena set partitions

Unfortunately, sets of phenomena are seldom available in convenient packages. Existing models and other referent assets are products of previous SIUs such that their fidelity (i.e., constituent phenomena elements as well as their range, precision, and accuracy) is seldom fully aligned with an emergent set of SIUs. The process of mixing and matching models of dissimilar fidelity is labor-intensive and generally calls for model modifications which can introduce and propagate unpredictable errors throughout legacy models.

In addition, the demand for decision-support information, and therefore the context of proposed simulation environment solutions, is constantly evolving making the process of conceptualizing, designing, and developing simulation environment solutions inherently iterative.

The proposed fidelity-oriented MDM approach is admittedly simplistic as it is at an early conceptual stage. But it does provide a fidelity framework that would normalize and facilitate an RE^3 (i.e., restructuring, reverse engineering, and re-engineering) process for establishing and evolving contextual phenomena sets of emergent SIU problem spaces and for tracking the make-up of corresponding simulation environment solutions composed from legacy models and other existing referent assets.

4 CONCLUSIONS

An initial approach was presented to translate the referent domain of a simulation problem space into MDM format for future analysis. The approach attempts to leverage familiar concepts in the M&S community such as fidelity, validity, and composability and considers coupling them into a DSM framework to facilitate syntactic and semantic analysis of simulation components for reuse and composition into distributed simulation environments. A key proposition is to describe fidelity in terms of “phenomena sets” that would serve as DSM domains in an MDM framework. Validation and composability of models would then be described in terms of the degree of correspondence between DSM domains that would characterize the SIUs, required fidelity, available fidelity, and emergent fidelity of models.

5 FUTURE WORK

A necessary next step would be to explore ways to leverage and/or extend DSM and MDM techniques (e.g., partitioning, tearing, banding, etc.) to support complexity management of distributed simulation environments. Extensions of these techniques would be directed at manifesting and correlating the range, precision, and accuracy of phenomena elements captured in legacy models in order to derive registration metrics between the DSM domains (i.e., SIUs, required fidelity, available fidelity, emergent fidelity). Such registration metrics would be used to objectively quantify the validation and composability of proposed simulation environment solutions.

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Exploring DSM to Support Systems Engineering of Composable Simulation Environments

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MANAGING COMPLEXITY
BY MODELLING DEPENDENCIES

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- Conclusions
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Motivation

- Composition Theory/Composability is Latest Frontier in M&S Discipline
- Composability Problems are Complex, Needs are Great, Standards and Formalisms are Lacking, Resources are Scarce
- Desire to Leverage Relevant Formalims –Including those in Complexity Managment Research
- DSM Methods Have Proven Effective in Various Engineering Settings
- How Can DSM Contribute to Composability Research/Solutions?

BY MODELLING DEPENDENCIES MANAGING COMPLEXITY

Background

- M&S Systems Engineering (M&S SE) Differs from Systems Engineering (SE)
- SE is Interdisciplinary Field of Engineering; Collaboration & Interaction
- M&S is Multidisciplinary Field; Non-Integrative Mixture of Disciplines
- M&S SE is a Mixture of the Two; Multidisciplinary Collaboration
- SE Mediates Technical and Business Concerns; Validates & Verifies System Solutions
- SE Validation Implies Building the Right System; SE Verification Implies Building the System Right
- Simulation Systems are Meta-Systems (i.e. Systems-within-Systems)
- M&S SE Validates & Verifies Simulation Environment Solutions
- M&S SE Validation Implies Building/Selecting the Right Models and the Right Infrastructure; M&S SE Implies Building the Models and the Infrastructure Right
- Distributed Simulation Environments that Address Complex Systems-of-Systems Present a Compounded Complexity as They Are Themselves Systems-of-Systems Involving Systems-within-Systems

Background (cont.)

- Validation & Verification of Simulation Environments is VERY HARD!
- Model Validation Involves Reconciling Disciplinary Syntactics and Sematics
- There are No Established/Authoritative M&S SE Standards to Provide Direction
- No significant Complexity Management Research Occurring in M&S
- Composition Theory/Simulation Composability is Current M&S Frontier; Closest Work Looking at Complexity of Distributed Simulation
- Composability refers to the capability to assemble simulation components in various combinations into valid simulation systems that satisfy specific intended uses; any set of components can be integrated and configured into a valid simulation environment given enough time and resources; composability implies a certain readiness of a set of components to be assembled into a valid simulation environment in a timely and reliable manner.
- Leading Composability Researchers Dismiss Illusion of Pure Plug-and-Play Distributed Simulation; Favor and Call for More Effective M&S SE Methods that Expedite Conceptualization, Design, and Development of Distributed Simulation Environments

MDM as Enabler of Fidelity-Based Composability

- M&S SE Formalisms and Standards are Hampered by Multi-Perspectivity Problem in the M&S and SE Communities
  - Multiple Connotations of Important and Familiar Terms and Concepts Add to Complexity
  - Fidelity, Composability, Validity, SIUs among many others
  - Fidelity is particularly controversial ... and a potentially game-changer; “High Fidelity” and “Low Fidelity” terms are meaningless for M&S SE
- Call for and Resistance to Common Lexicon/Taxonomies and M&S SE Standards is Often About Cost vs. Benefit
- An effective M&S SE approach should consider a framework that reconciles (and leverages the familiarity of) Fidelity, Specific Intended Uses, Composability, Validation, and Possibly Others
- MDM Offers Potential for Persuasive Fidelity-Based M&S SE Framework Because of Its Simplicity and Intuitiveness if it Translates into Low Overhead

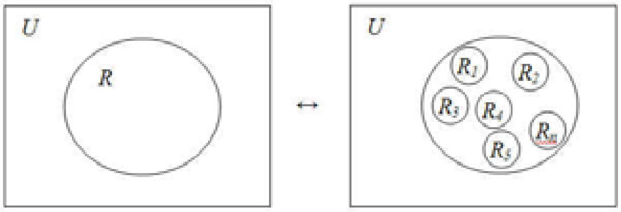
MDM as Enabler of Fidelity-Based Composability

- In General, Arbitrary Sets of Referent Characteristics are Coded into Models (*Referent refers to the sum total of what is known, assumed, or projected about a natural or man-made system*)
- Let's Liberally Define "Sets of Phenomena" to be Referent Characteristics (i.e., Things, Facts, Events of Interest)
- Fundamental Phenomena (e.g., time, space, mass, energy) Combines into More Complex Phenomena (e.g., velocity, density, power)
- The Context of a Problem Space and the Scope of a Proposed Simulation Environment Solution Can Be Expressed in Terms of Sets of Phenomena

MDM as Enabler of Fidelity-Based Composability

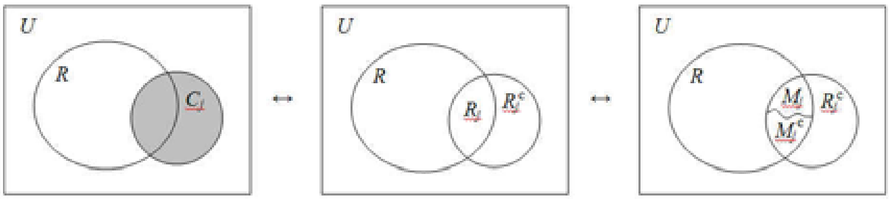
- Fidelity would Refer to the Range, Precision, and Accuracy of the Elements of Phenomena Sets
    - Required Fidelity would Refer to the Phenomena Context of the SIU Problem Space; that is, the Relevant Phenomena that Needs to be Involved in Order to Resolve SIUs (*Specific Intended Uses are akin to hypothesis statements that present questions of interest or information needs*)
    - Available Fidelity would Refer to Phenomena Sets Encoded into Models
    - Emergent Fidelity would Refer to the Phenomena Sets that Need to be Encoded into Models in Order to Satisfy a Set of SIUs
- Validation would Become a Mapping Process to Ensure that Required Fidelity is Satisfied by Available Fidelity and Emergent Fidelity
- Verification would Become a Process to Ensure that Simulation Environment Solution is Valid and that Results are within Expected Tolerances
- Composability would Become the Degree to which the Available and Emergent Fidelities Correspond to the Required Fidelity

MDM as Enabler of Fidelity-Based Composability



$U \triangleq$ *universal set of phenomena* $= R \cup R^c$

$R \triangleq$ *set of total known phenomena (i.e., all referents)* $= R_1 \cup R_2 \cup \ldots \cup R_n$



$C_j \triangleq$ *set of phenomena of interest that depicts SIU context*

$R_j \triangleq$ *set of SIU-aligned phenomena encapsulated by particular referent(s)*

$R_j^c \triangleq$ *set of SIU-aligned phenomena that expands referent(s)*

$M_j \triangleq$ *set of SIU-aligned phenomena from referent coded into models*

$M_j^c \triangleq$ *set of SIU-aligned phenomena from referent not coded into models*

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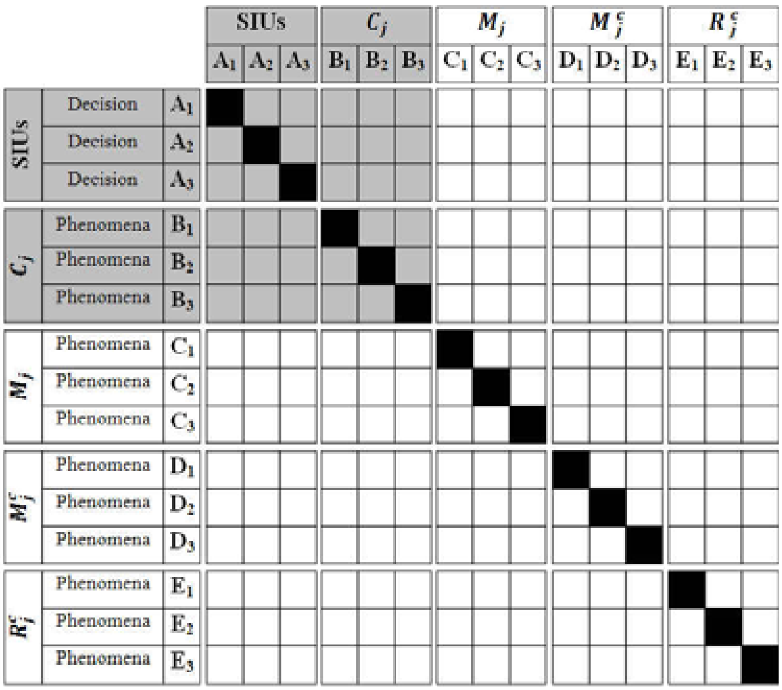
MANAGING COMPLEXITY

MDM as Enabler of Fidelity-Based Composability



Conclusions

- Initial Approach Presented to Translate Referent Domain of Simulation Problem Space into MDM Format for Future Analysis
- Approach Leverages Familiar Concepts in the M&S Community (e.g., Specific Intended Uses, Fidelity, Validity, Composability)
- Approach Considers Coupling SIUs and Fidelity into MDM Framework
- Fundamental Phenomena (e.g., time, space, mass, energy) Combines into More Complex Phenomena (e.g., velocity, density, power)
- Key Proposition is to Express Context of a Problem Space and Scope of a Proposed Simulation Environment Solution in Terms of Sets of Phenomena
- Phenomena Sets to serve as DSM Domains in MDM Framework
- Validation and Composability to be Described in Terms of Degree of Correspondence Between DSM Domains

Future Work

- Explore Ways to Leverage and/or Extend the MDM and DSM Techniques to Support Complexity Management of Composable Simulation Environments:
  - Express, Manifest, and Correlate Range, Precision, and Accuracy of Phenomena Elements
  - Detect Fidelity Variations Among Phenomena Elements of DSMs in an MDM Framework
  - Quantify Fidelity, Validity, and Composability
  - Automate Generation of Emergent Fidelity Specifications
  - Automate Generation of RE3 Specifications for Model Modifications
  - Incorporate a Process Grammar for SIU Probelm Space Description
  - Automate Generation of Interoperabilty Specifications (e.g., HLA FOMs)