Paper: Entropy Measures for System Identification and Analysis

Author Response Record

Topic	*Reviewer Comment*	*Author Response*
Typographical, spelling errors	R1-C01: Superscripts, grammatical changes needed	The paper was reviewed and rewritten to add readability.
Narrative about "use"	R1-C02: To discuss the use of the concept is to capture the reader's attention. Now the reader wants to understand the usage, but then there's just more discussion about "uses." Readability is improved if the term "use" is edited out.	The paper was reorganized to support three main examples of metric use and application. Readability edits applied throughout the paper. Further, a new metric called a subsystem score was developed to further clarify the authors main theme and intent.
Metric of disorder	R1-C03: Once metric makes disorder observable, then what?	The application of the metrics are highly domain specific, however, there are domain independent aspects of the metrics that are more fully developed in the rewritten paper. These numerical metrics provide the basis for automated disorder discovery and identification.
Complexity	R1-C04: How is complexity clearly distinguished from disorder:	The authors define a range of complexity from cognitive complexity to computational complexity in this and other papers. Disorder is associated with physical entropy. Disordered systems that have no organizational theme are cognitively complex. Systems that have an organizational theme may be ordered using that theme and therefore become less cognitively demanding.
SE defined	R1-C05: p1. Two definitions are offered. They should be labeled A and B, then referenced as A or B, with a reason why both are needed.	The authors have defined and used these system definitions in previous papers. The key distinction in this paper is the construction rule used to define a system has two groups of things, objects and relationships. Physical entropy is associated with the relationships and information entropy is associated with the objects. The functional definition of a system is used to define the boundaries of system configuration and form.
SE defined	R1-C06: Suggest on p1, 2nd paragraph: Change "These entropy measures and metrics then provide a direct connection between systems science and the practice of systems engineering.", to "… measures and metrics provide a ***mathematically*** direct connection …"	A key aspect of systems science developed by John N. Warfield, is the equivalence of prose, graphics and mathematics. The subsystem grouping provides a mathematical transform from numerical datatypes to prose datatypes. When the marks (or ones (1)) in the matrix are arranged in a specific subspace of the system space then these numerical marks are transformed in to a categorical class which is identified using prose (a "subsystem" is used as a generic name.) So, there are direct mathematical, prose and graphical connections represented in this paper.
"Encode"	R1-C07: Needs definition of its special meaning in this paper	The paper has been updated to add definitions in many places.
Figure 1	R1-C08: p2. Readability and comprehension is improved if columns are given symbols that suggest the defined category. Example, instead of label of A, enter column label M for Manual. Makes a mental migraine go away.	The graphic has been updated but the column heading were not changed at this time.
Point made too early with no rationale	R1-C09: p2, 2nd paragraph, 1st sentence. "These system analysis techniques all address the reduction of disorder in systems." First explain kinds of disorder and how each	This type of explanation is found in the authors previous work. The type of disorder addressed in this paper (physical entropy) is addressed later in the paper.

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	technique fixes this, then the reader will agree.	
"aforementioned"	R1-C10: p2, 2nd paragraph, 2nd sentence. "The aforementioned system analysis techniques are related to the concept of physical entropy by the introduction of order into a system structure." A better adjective is "Figure 1 methods". Don't know how this figure can be called an allocation. The sentence itself is an unsupported claim.	The cited literature details the production of system order using these techniques. The claim is the connection between order and entropy which should be quite clear. Low entropy means low disorder, high entropy means high disorder.
Title for Figure 3	R1-C11: p4. It doesn't help to say "Graphical Map of System Definition" (referring to Definition A or Definition B from page 1?). How about "Marking Space Map of Objects that Constitute a System (Definition A)"	Figure 3 Title has been changed to, "Figure 3. ART Marking Space Graphical Map of System Components."
disorder	R1-C12: p4, 3rd paragraph, 1st sentence. "The primary property or characteristic associated with physical entropy is the concept of disorder." Reserve "concept" for something important. Disorder can be understood without terming it a concept. It should be a property or characteristic – writer's choice. Why allow reader to choose? Defeats the purpose of semantic simplicity.	The word concept has been removed, the rest of the sentence is the same.
Figure 3 – which definition of SE?	R1-C13: p5, 1st sentence. "Figure 3 provides a graphical map that depicts the system definition of "a system is a relationship mapped over a set of objects."" Suggest: … ***depicts the "A" definition of a system as relationships*** mapped …"	The text in this area has been rewritten and reorganized to increase readability. This specific suggestion was accepted and incorporated in the revised paper.
Figure 5	R1-C14: p6. What is the reason for ignoring the 5x5 N-Squared chart in Figure 3, and then not showing how a 9x9 N-Squared chart is analyzed for FS/FR/BS/BR to produce Figure 5?	The text and graphics have been rewritten to make the process and calculations more clear.
Figure 7	R1-C15: p8. Why is Figure 7 discussed when the 5x5 FS/FR/BS/BR analysis process method was skipped? If this is not explained, the remaining figures lose their meaning.	The text and graphics have been rewritten. Reviewer one was unable to complete and verify the basic calculations in the draft working paper. Therefore the paper was extensively reorganized and rewritten to more clearly convey the process and procedure.
History of DSM, DSM Type	R2-C01: Although Steward coined the term DSM, his work deals exclusively with temporal (process) models; he never does clustering.	See "Supporting Documentation for the Comment Response Record Entropy Measures for System Identification and Analysis "
DSM Clustering Focus	R2-C02: While the term DSM has grown to encompass static models (which are usually clustered), this is not due to Steward.	See "Supporting Documentation for the Comment Response Record Entropy Measures for System Identification and Analysis "
Method Comparison	R2-C03: You should compare your approach with the published clustering approaches.	See "Supporting Documentation for the Comment Response Record Entropy Measures for System Identification and Analysis "

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Evolutionary Computation Example	R2-C04: One that uses evolutionary computation is attached.	See “Supporting Documentation for the Comment Response Record Entropy Measures for System Identification and Analysis “
DSM Model Conversion	R2-C05(a): Be careful about putting too much faith in any result from an NxN model when the same system could also be modeled in greater detail (e.g., as a 2Nx2N model).	See “Supporting Documentation for the Comment Response Record Entropy Measures for System Identification and Analysis “
DSM Scale-Free Metrics	R2-C05(b): One of the big desires in this area of research is a “scale-free” measure that holds no matter what level of analysis is chosen by a modeler.	See “Supporting Documentation for the Comment Response Record Entropy Measures for System Identification and Analysis “
Levels of Entropy	R2-C05(c): The same system should not have different levels of entropy depending on the level of abstraction at which it is viewed (an observer-dependency).	See “Supporting Documentation for the Comment Response Record Entropy Measures for System Identification and Analysis “
Proposed Metric Adjustment	R2-C05(d): A step in the right direction might be to normalize your metric as a ratio to N (matrix size), but even this is not enough since the number of combinations does not grow linearly with N, so perhaps you will have to normalize against the maximum number of combinations in a matrix of size N.	See “Supporting Documentation for the Comment Response Record Entropy Measures for System Identification and Analysis “
Proposed Metric Adjustment Abstraction	R2-C05(e): However, the challenge then becomes that as a system is modeled at deeper levels, the matrix tends to get sparser.	See “Supporting Documentation for the Comment Response Record Entropy Measures for System Identification and Analysis “
DSM Metric	R2-C05(f): Therefore, I’m not sanguine about any metric based solely on a binary DSM.	See “Supporting Documentation for the Comment Response Record Entropy Measures for System Identification and Analysis “

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