Abstract

Complexity measurement of a cyber-physical system is a part of multimillion dollar project funded by DARPA (Defense advance research project agency). The objective of complexity measurement of a cyber-physical system is to find out the main components and constituent of complexity in a design process of cyber physical system. These complexity components can be further use to (a) estimate the cost of cyber-physical system, (b) develop methods that can reduce the cost of cyber-physical system and (c) make decision such as selecting the design from a set of possible solutions or variants.

The first step in this is to research to find out all the possible component of complexity. Based on the surveys and rationale three components are found which contribute to the complexity of the system. These components (domains) are: Artifact complexity, Design process complexity and Manufacturing complexity. All domains were represented as Line graphs (networks), but with different interpretations of entity (node) and relation (link) corresponding to the above three aspects. Complexities of these components are measured using algorithms defined in graph theory.

Two experiments were conducted for the verification of the complexity measures. The first experiment was a mechanical transmission and the scope of this experiment was component level. All the design stages, from concept to manufacturing, were considered in this experiment. The second experiment was conducted on hybrid powertrains. The scope of this experiment was assembly level and only artifact complexity is considered because of the limited resources.

Finally the calibration of these complexity measures was conducted by Boeing. The results of the experiments shows us that the weighted mobility, weighted Information content and total weighted size are good measure of complexity. Data structure, fast algorithms and software for complexity calculations for large cyber physical systems were also developed.