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Abstract
Systems engineering introduces the notion of top-down design, which involves viewing an entire system comprised of its components as a whole functioning unit. This requires an understanding of how those components efficiently interact, with optimization of the process emphasized rather than solely focusing on micro-level system components. The traditional approach to the systems engineering process involves requirements decomposition and flow down across a hierarchy of decision making levels, in which needs and requirements at one level are transformed into a set of system product and process descriptions for the next lower level. This top-down requirements flow approach therefore requires an iterative process between adjacent levels to verify that the design solution satisfies the requirements, with no direct flow between nonadjacent hierarchy levels. This thesis introduces a methodology that enables decision makers anywhere across a system-of-systems hierarchy to rapidly and simultaneously manipulate the design space, however complex. A hierarchical decision making process will be developed in which a system-of-systems, or multiple operationally and managerially independent systems, interact to affect a series of top level metrics. This takes the notion of top-down requirements flow one step further to allow for simultaneous bottom-up and top-down design, enabled by the use of neural network surrogate models to represent the complex design space. Using a proof-of-concept case study of employing a guided projectile for mortar interception, this process will show how the iterative steps that are usually required when dealing with flowing requirements from one level to the next lower in the systems engineering process are eliminated, allowing for direct manipulation across nonadjacent levels in the hierarchy. For this system-of-systems environment comprised of a Monte Carlo based design space exploration employing rapid neural network surrogate models, both bottom-up and top-down design analysis may be executed simultaneously. This process enables any response to be treated as an independent variable, meaning that information can flow in either direction within the hierarchy.

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insight into its compositional sub-systems. Methodological base of development of weapons Programs is a set of techniques and mathematical models to determine the performance effectiveness of combat application of different sets (samples) of IWT in various conditions, as well as a complex economic models designed to determine the cost of development and production of military equipment. In) system constraints, defining ranges of varying parameters to be optimized (in the design of technical systems these constraints are usually referred to as project); g) optimizing a procedure that allows to determine under the given constraints, the best option on the selected system of indicators, or one generalized measure.