A Game-Theoretical Framework for Team Coordination in Requirement-Based Engineering Design

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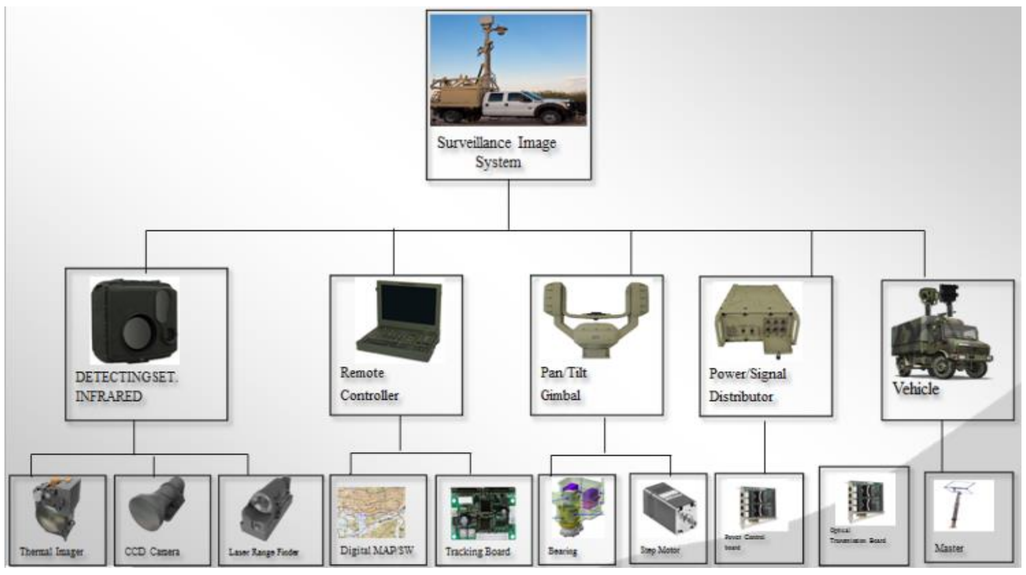
PURPOSE / PROBLEM

Large System Design Hierarchy



- In the design of large systems, component or subsystems are designed by different design teams who utilize shared resources.
- Requirement based engineering design is one approach that allocates a portion of the design resources to each of the design teams.
- We take a high-level approach to study requirement-based engineering design limitations and challenges.

METHODOLOGY

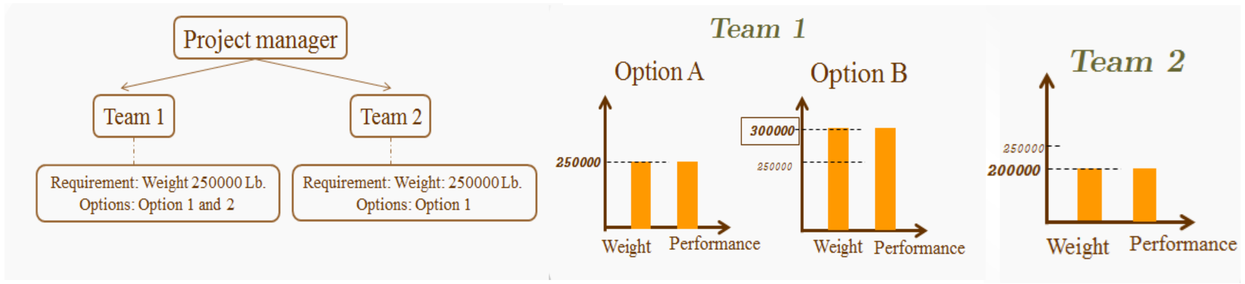
- By using non-cooperative game theory, we can show that requirement based engineering design does not result in the best design of the entire product.

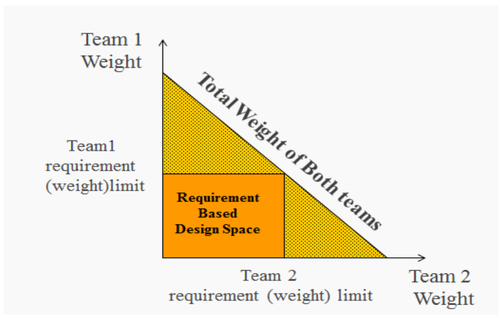
METHODS / DESCRIPTION

large system example, Aircraft

- Goal: Maximize the power with weight limitation no more than 500,000 pounds
- Task: Resources allocation such as mass, power, etc.
- Assumption: Aircraft system with two subsystems (for simplicity)

METHODS / DESCRIPTION





Design teams only meet the specified requirement and the performance at the system level may suffer.

RESULTS

The total cost for the entire system is higher under requirement based design

$$C^P \leq C^R$$

The equilibrium effort level for each team i under requirement based design is

$$e_{ij}^* = \frac{a_{ij} - A_{ij}}{C_{ij}} \quad \text{for all j}$$

The equilibrium effort level for each team i in a centralized system is

$$e_{ij}^* = \left(\frac{C_{ij}}{k_{ij}}\right)\left(\frac{\sum_{i=1}^{n}(a_{ij} - A_{ij})}{\sum_{i=1}^{n}\frac{C_{ij}^2}{k_{ij}}}\right) \quad \text{for all j}$$

CONCLUSIONS

- Rrequirement based engineering design cannot always achieve the optimal performance for the entire system.
- Design teams will do the best to meet the requirements but they don't have incentive to design a better product.

CONTACTS / REFERENCES

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