Design Environments and Manufacturing Integration

CPS PI Meeting
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Presented by:
Mark T. Traband, PhD
mtt1@arl.psu.edu
DARPA’s Adaptive Vehicle Make (AVM) Portfolio of Programs

...seeks to revolutionize the design and build process for complex defense systems by compressing the development timelines at least *five fold* while increasing the nation’s pool of innovation by several factors of 10.

iFAB - Instant Foundry Adaptive through Bits

The creation of a flexible, programmable, distributed production capability able to accommodate a wide range of systems and variants with extremely rapid reconfiguration timescales.

*A network of Information, Material, and Agreements*
Key Challenges for iFAB

• Answer 1000+ queries/day as to whether a design is manufacturable

• Define Pareto front of feasible fabrication and assembly approaches for each design (cost versus lead-time).

• For a particular foundry configuration, generate
  – CNC instruction sets for all manufacturing equipment
  – Human work instructions

• Execute build across a heterogeneous, distributed enterprise
Challenge Design

Load STEP Assembly

Decompose Model
Software & algorithms

Assembly Planner
Software & algorithms

MFG Analysis for Each Piece Part

Schedule

aPriori
Virtual Production Environment
Machined, cast, plate, tubing

Deterministic & stochastic
Scheduling algorithms & visualization

ARL Manufacturing
Model Library Components

CNC-Rapid Prototyping
Iowa State Univ.

Automated Manufacturability Feedback Assessment (PARC)

Feedback
Yes – Cost & Schedule
No – Cause & Correction

Feedback: Below recommended bend radius – may cause surface cracking
Possible CPS Contribution Areas to Manufacturing

• Geometric Reasoning (on real-world sized problems)
  – Feature extraction/mapping – design to manufacturing
  – Analysis – tooling, fixturing, path planning

• Sequential decision making under uncertainty
  – Problem dimensionality precludes a priori preference capture
  – Compounded in distributed enterprise

• Enabling democratized design – promoting the AVM paradigm, while:
  – Protecting IP in an agent marketplace
  – Facilitating business agreements
  – Expanding enterprise reach/appeal

End Game: Flash Mob Manufacturing