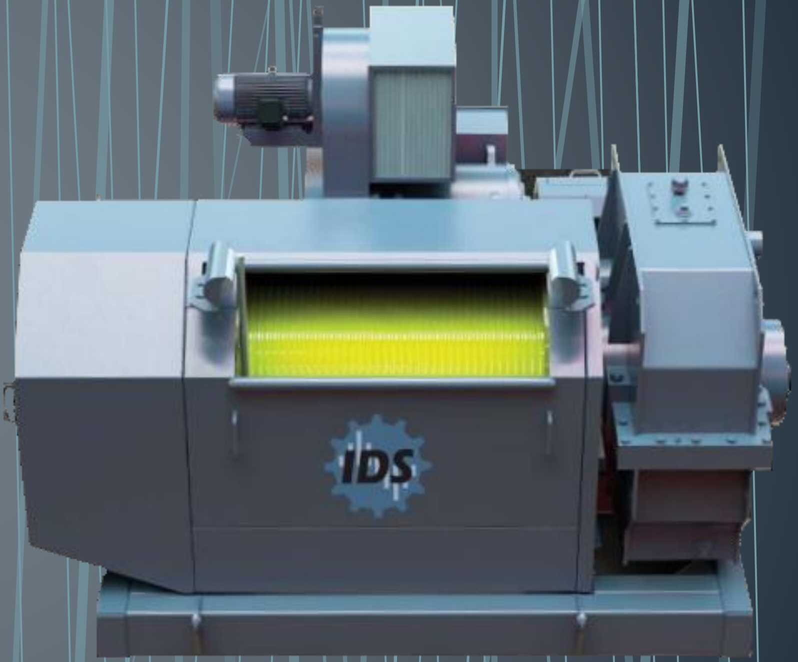
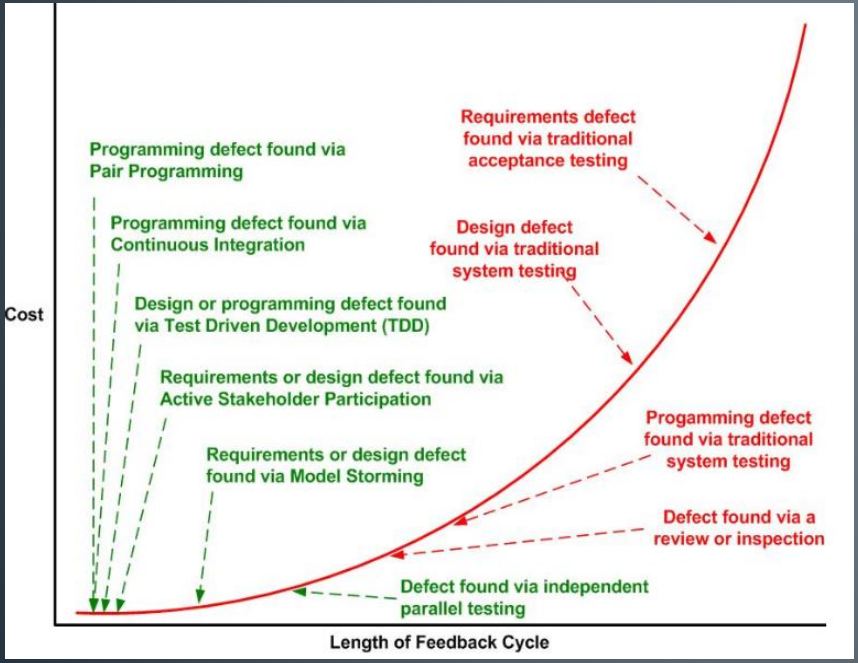
MODEL BASED DEVELOPMENT OF AC DRAWWORKS USING MATLAB

MathWorks Conference
25 April 2019
Houston, TX

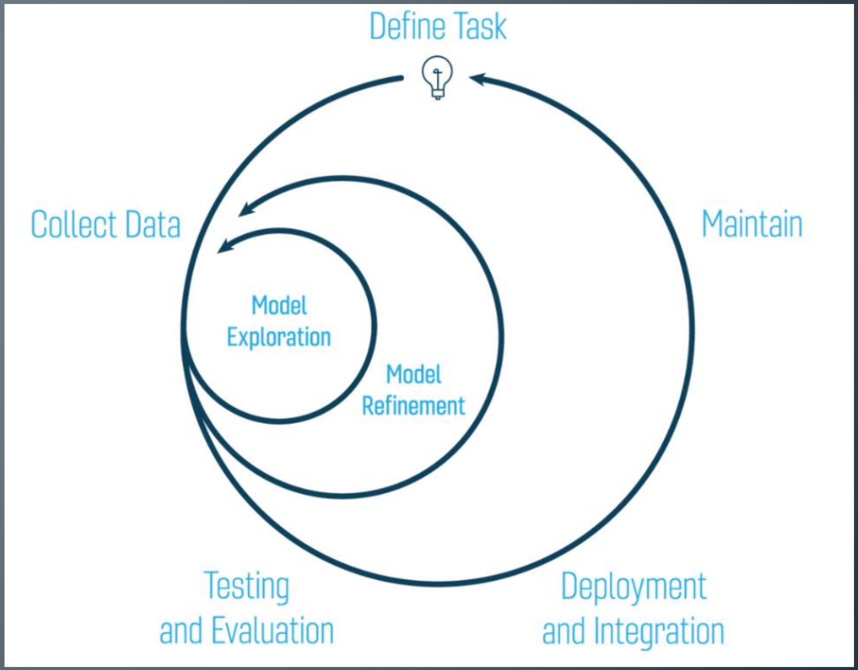


COST EFFECTIVE WORKFLOW

Traditional



Model Based



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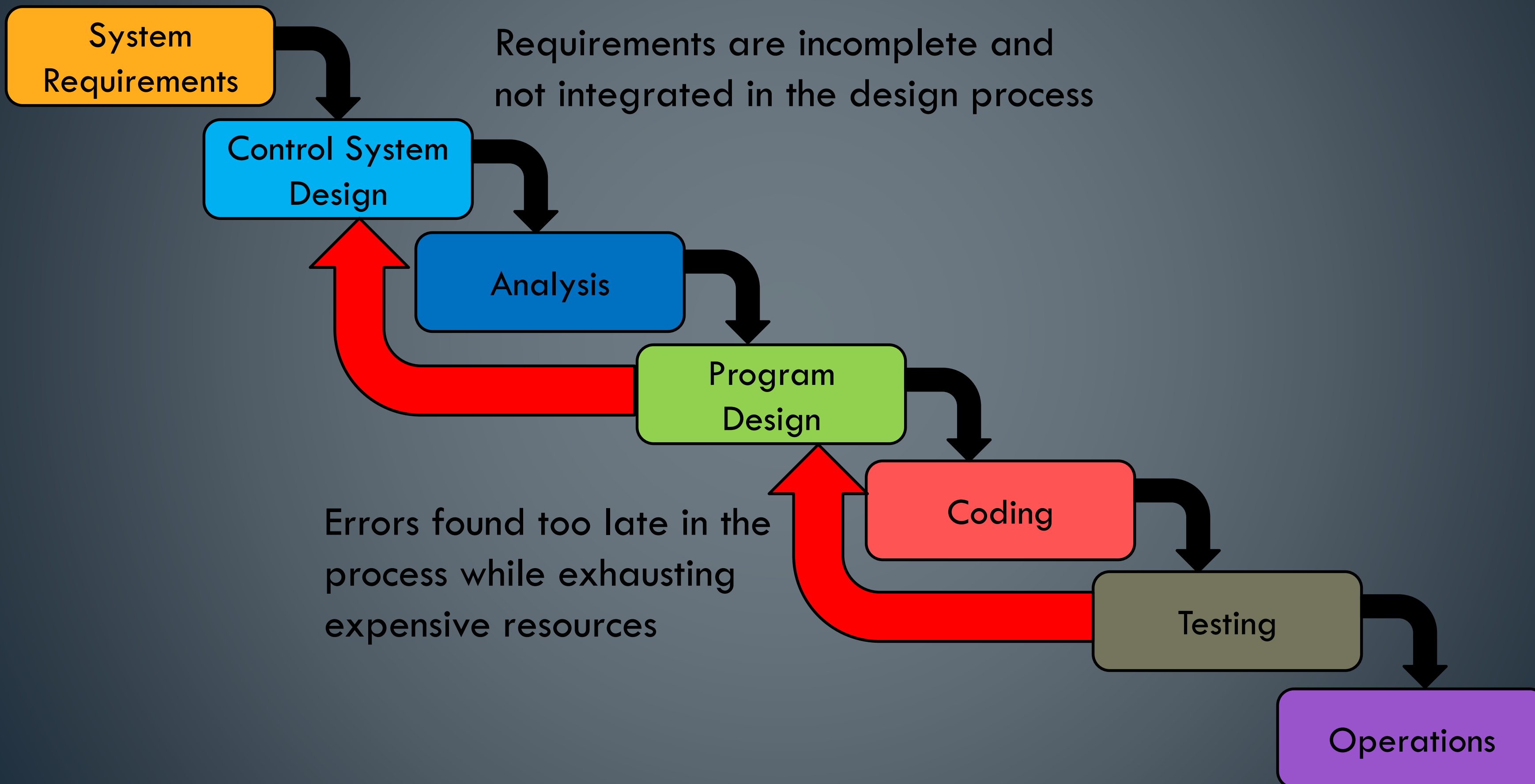
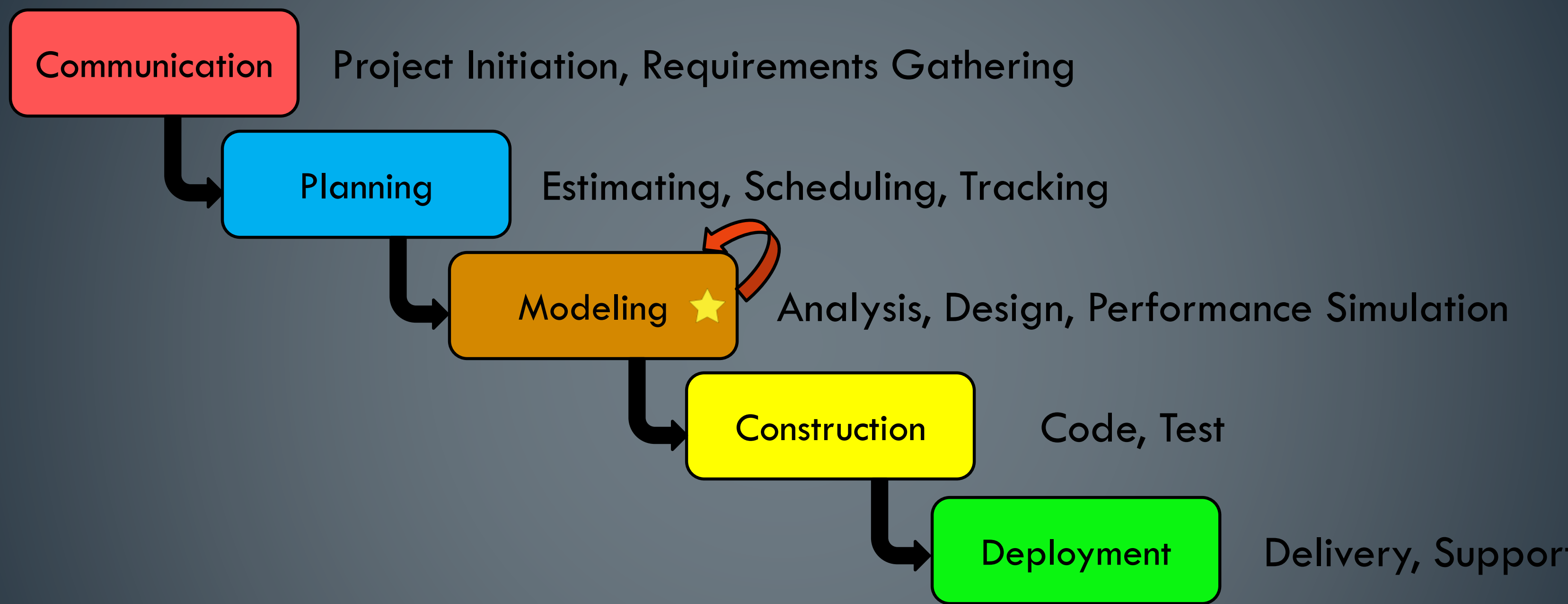
TRADITIONAL APPROACH



Requirements are incomplete and not integrated in the design process

Errors found too late in the process while exhausting expensive resources

MODEL BASED APPROACH



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SYSTEM MODELING

Uses of System Models

- Simulation, Visualization
- Static System Analysis, Formal Verification
- Virtual Fault Injection
- Synthesis of Implementations & Test Suites
- Documentation, Presentation

MODEL BASED APPROACH

Step 1: Modeling a Plant

- Incorporating Mechanical and Electrical aspects of all the underlying components.
- Identifying Rig dynamics and states that affect the process operation.
- Assessing Inertia of each mechanical component in the assembly and adjusting for Potential Energy.
- Combining all of them with the help of MathWorks tools and creating a functional model.

SOLIDWORKS +

+

→ MathWorks

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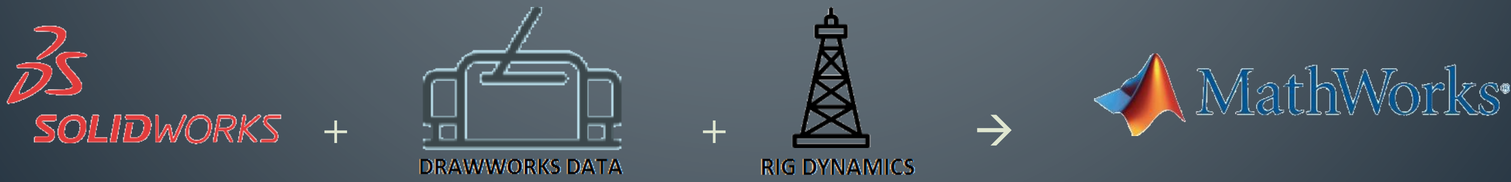
MODEL BASED APPROACH

Step 2: Analyzing and synthesizing a controller for the Plant

- Mathematical Model thus conceived is used to identify dynamic characteristics of the Plant model.
- Objective is to incorporate all the I/O and control the equipment in an optimum manner without delay or overshoot and ensuring control stability.
- Requisite corrective behavior is achieved.
- System ID and Control Systems Toolboxes are utilized to fine tune nuances.



MODEL BASED APPROACH

Step 3: Simulating the Plant and Controller

- Time response of the dynamic system to complex, time-varying inputs is investigated.
- Simulation allows specifications, requirements and modeling errors to be found immediately, rather than later in the design effort.
- Controller can be optimized with the virtual Plant model and can be made compatible to be converted into Machine Code for release on a industrial processor.

SOLIDWORKS +

DRAWWORKS DATA

+

RIG DYNAMICS

→ MathWorks

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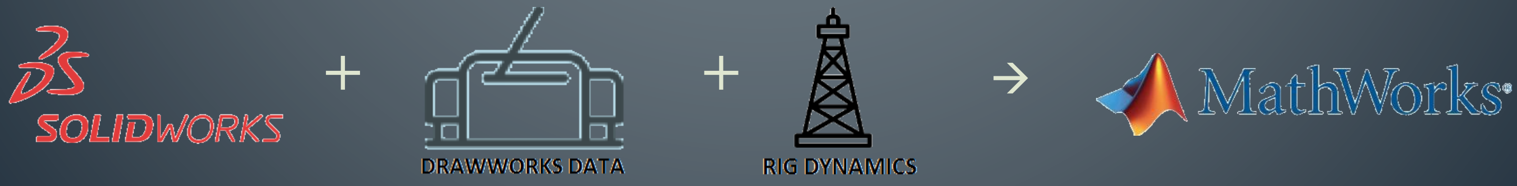
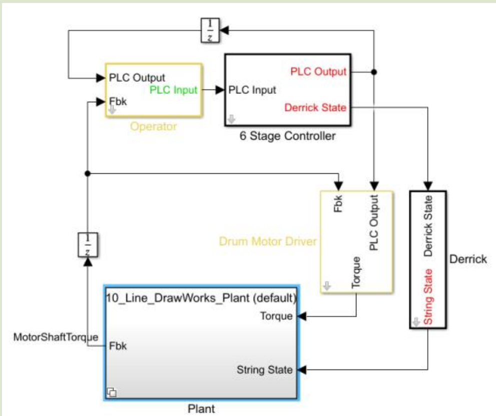
MODEL BASED APPROACH

Step 4: Integrating all phases and Deploying the Controller

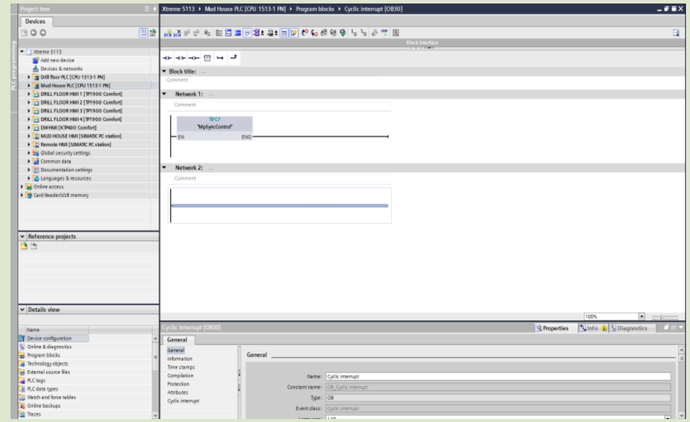
- Ideally done via automatic code generation from the controller developed in Step 2.
- Controller performance is not perfect in real world condition.
- An iterative debugging process is carried out by analyzing results on the actual target and updating controller model further.
- All of the above can be done in a Graphical Interface.



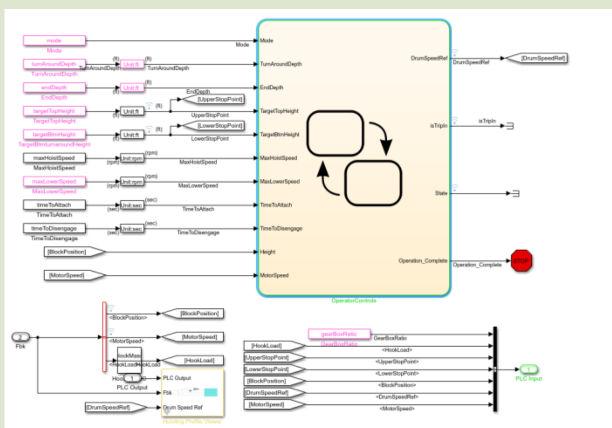
Design



Implement



Simulate



Deploy

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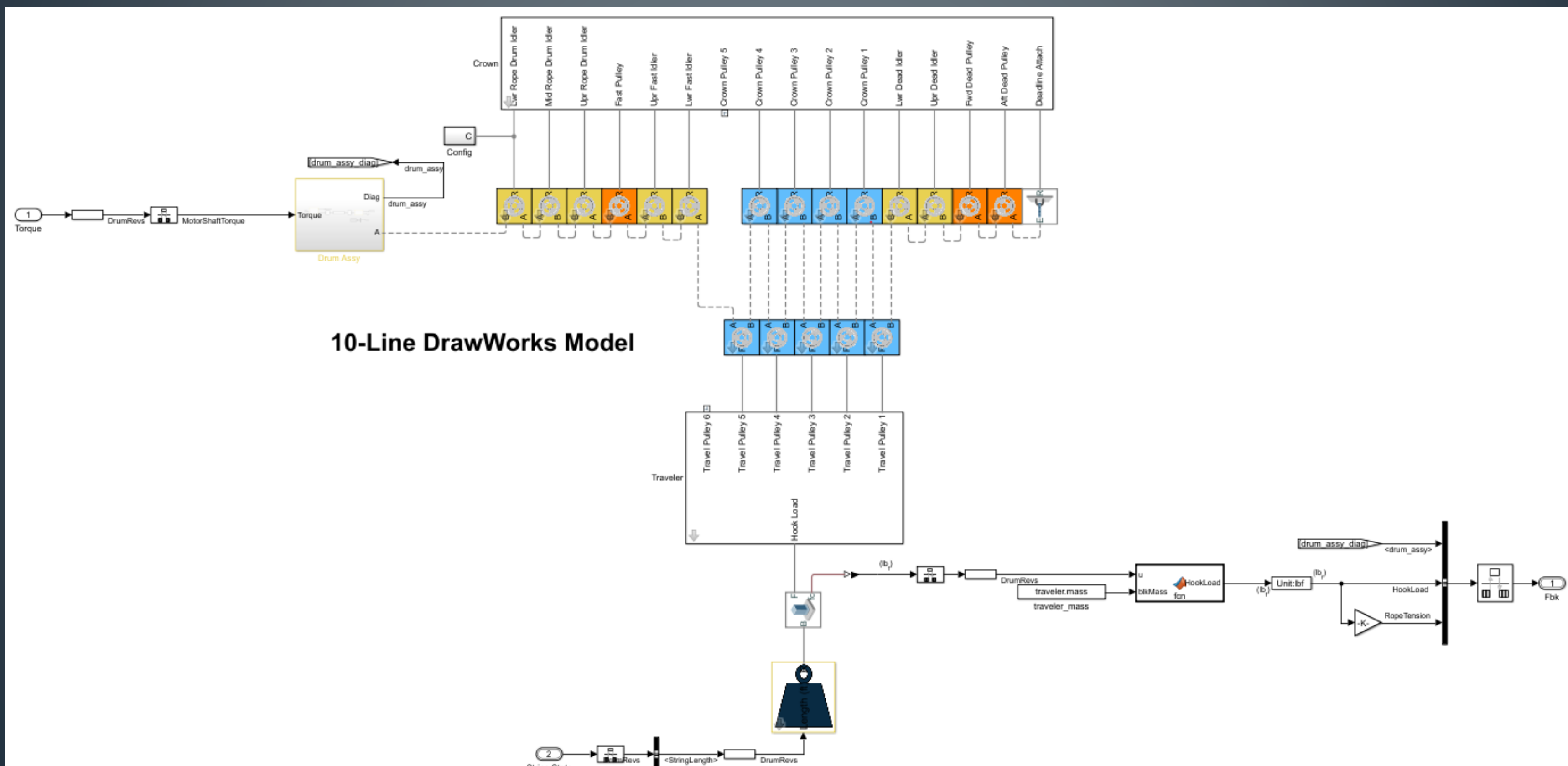
10 LINE DRAWWORKS MODEL



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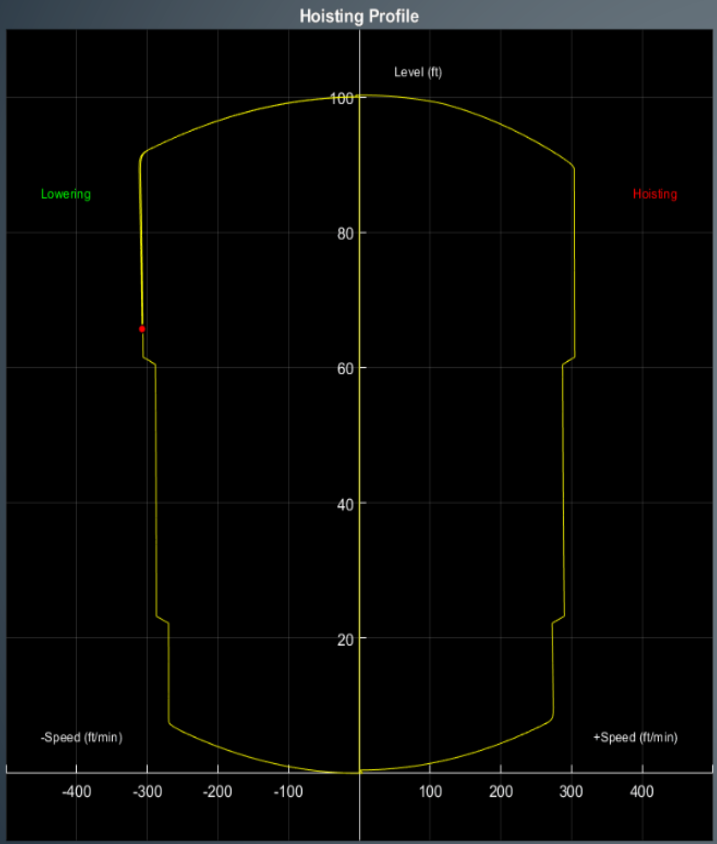
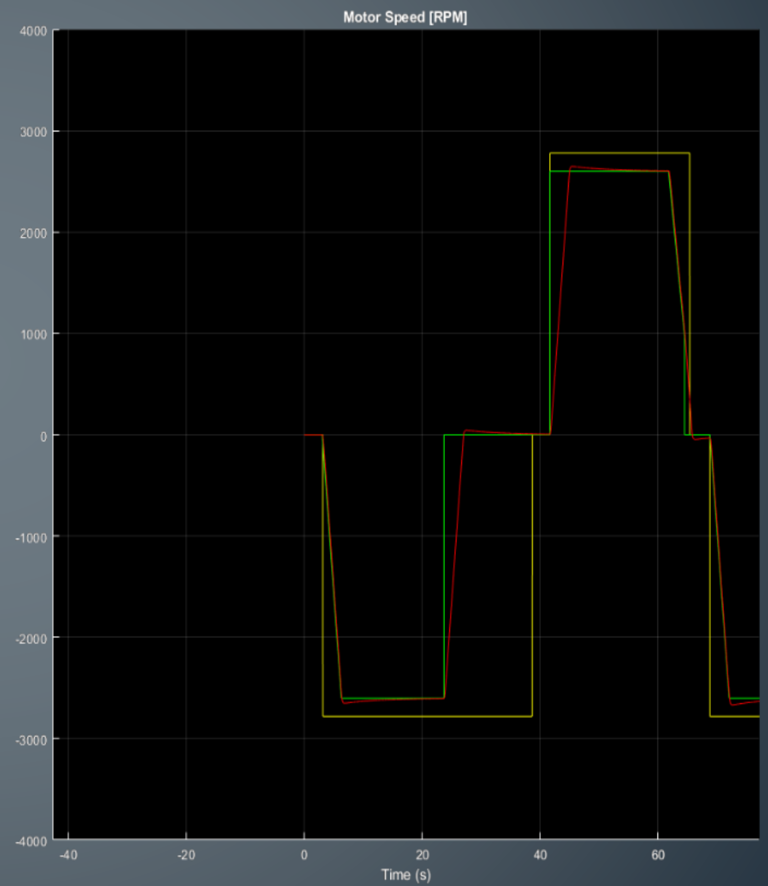
Result of Simulation: Block Performance and Motor Performance





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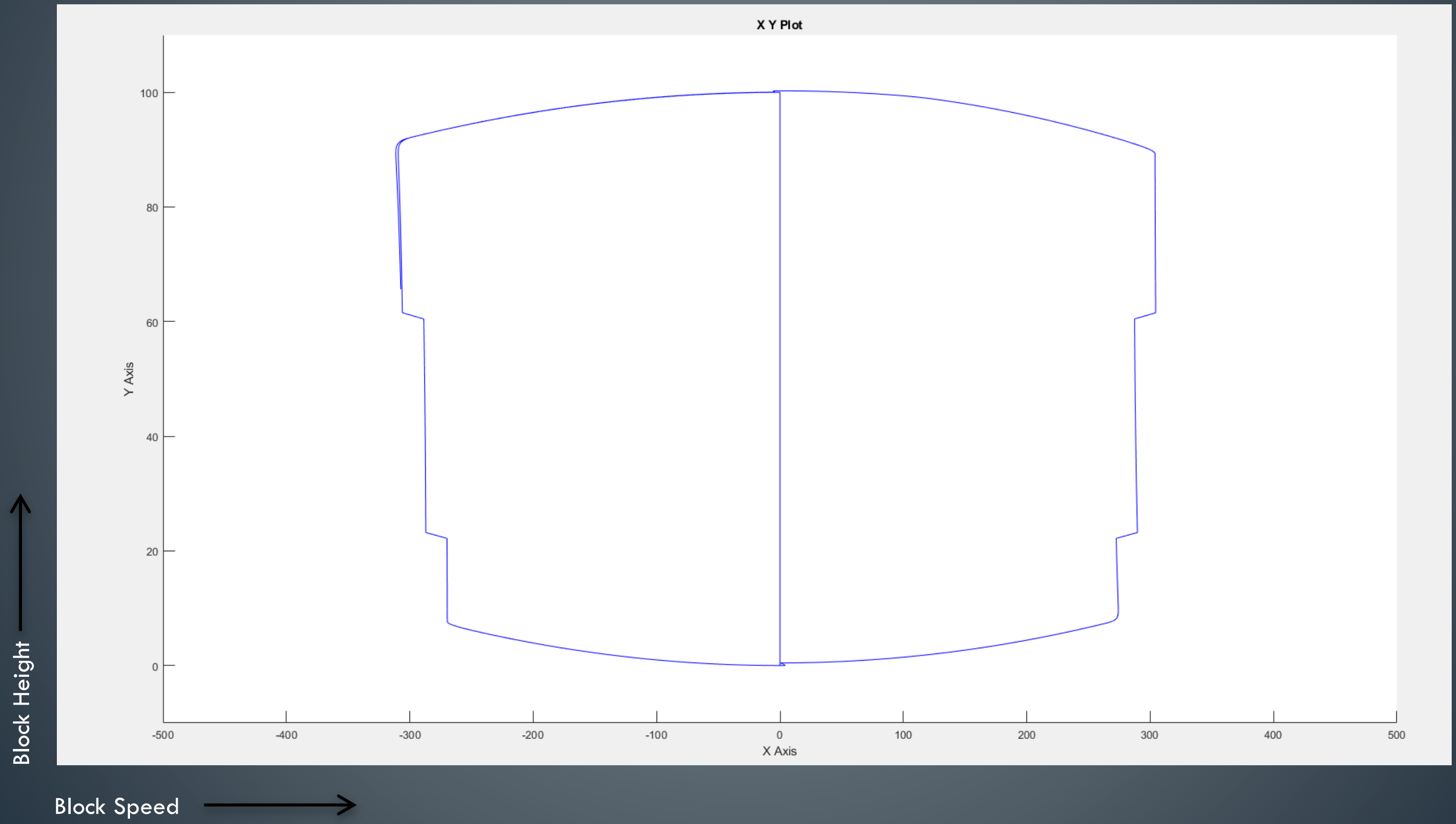
IDEAL CURVE



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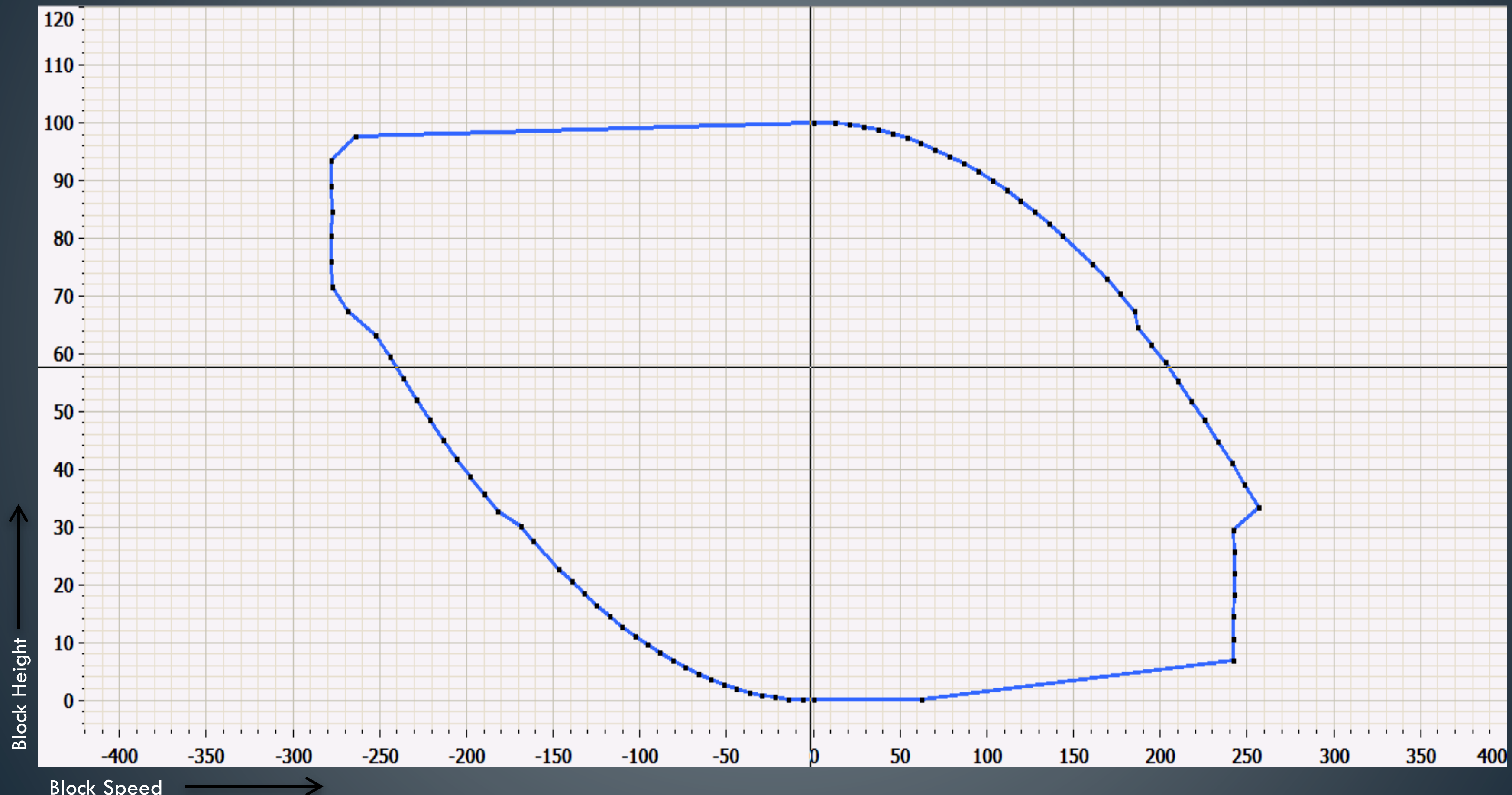
ORIGINAL



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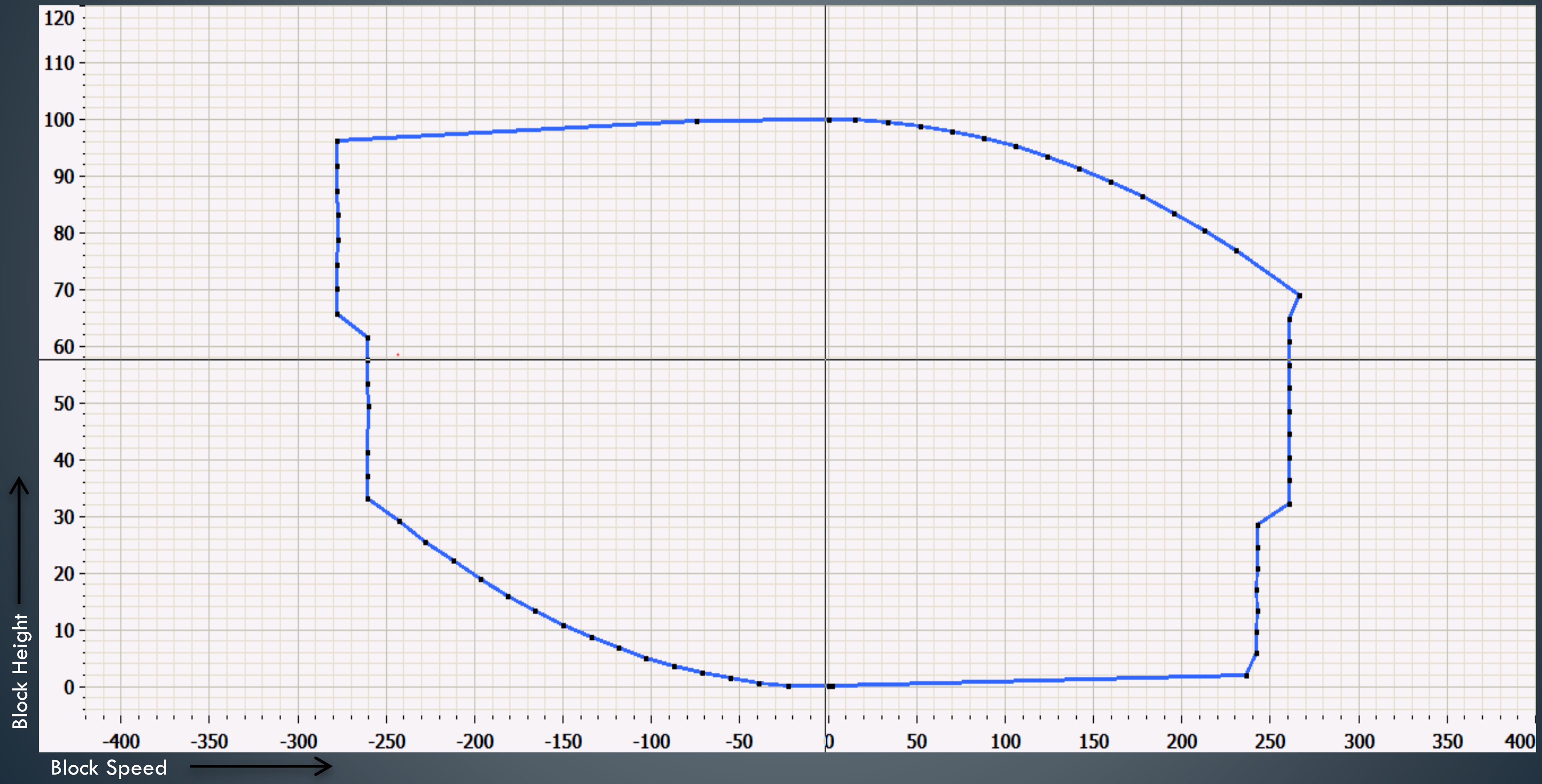
SPEED IMPROVEMENTS



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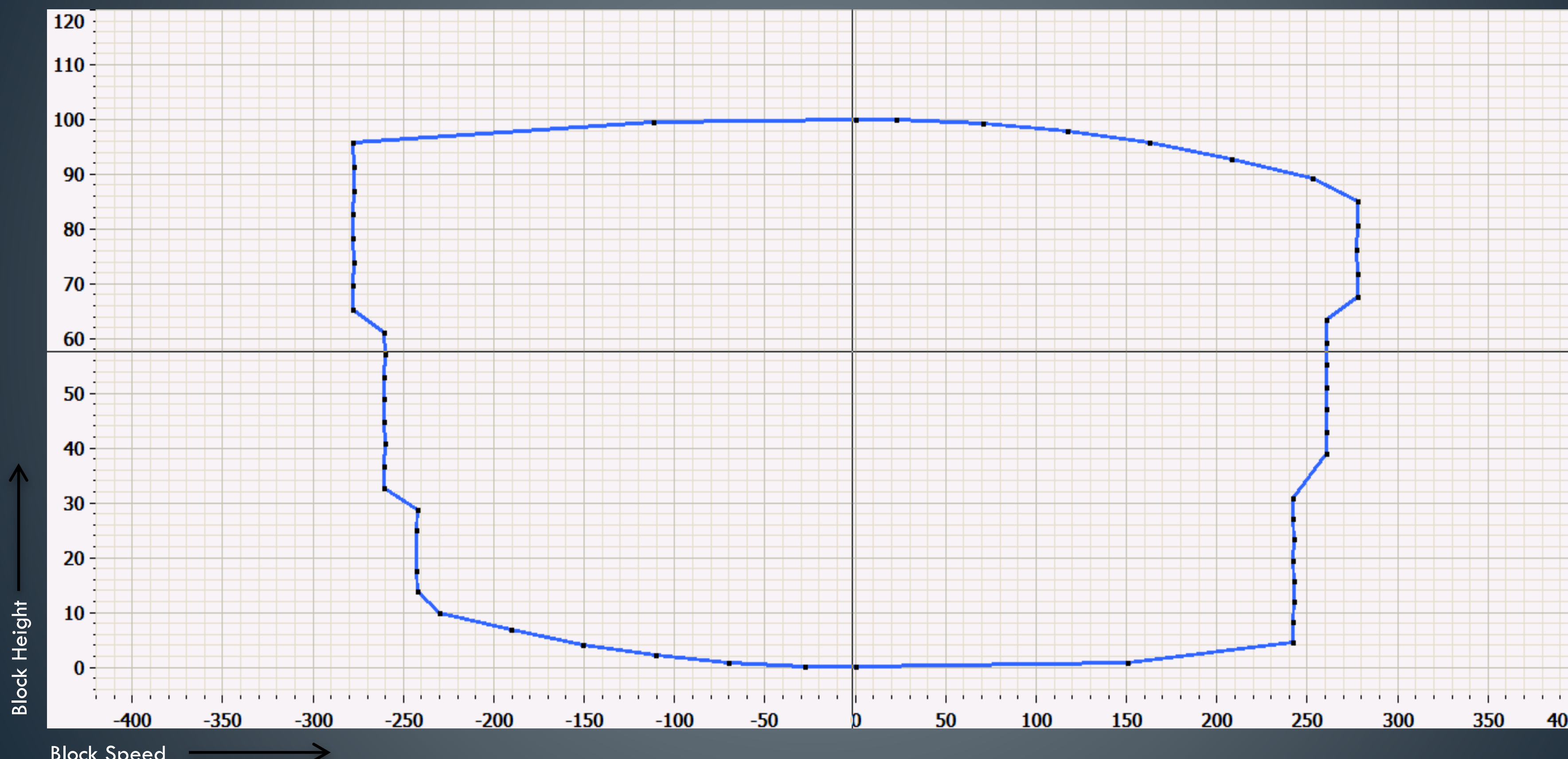
Ideal Kinetic Energy Zone Management



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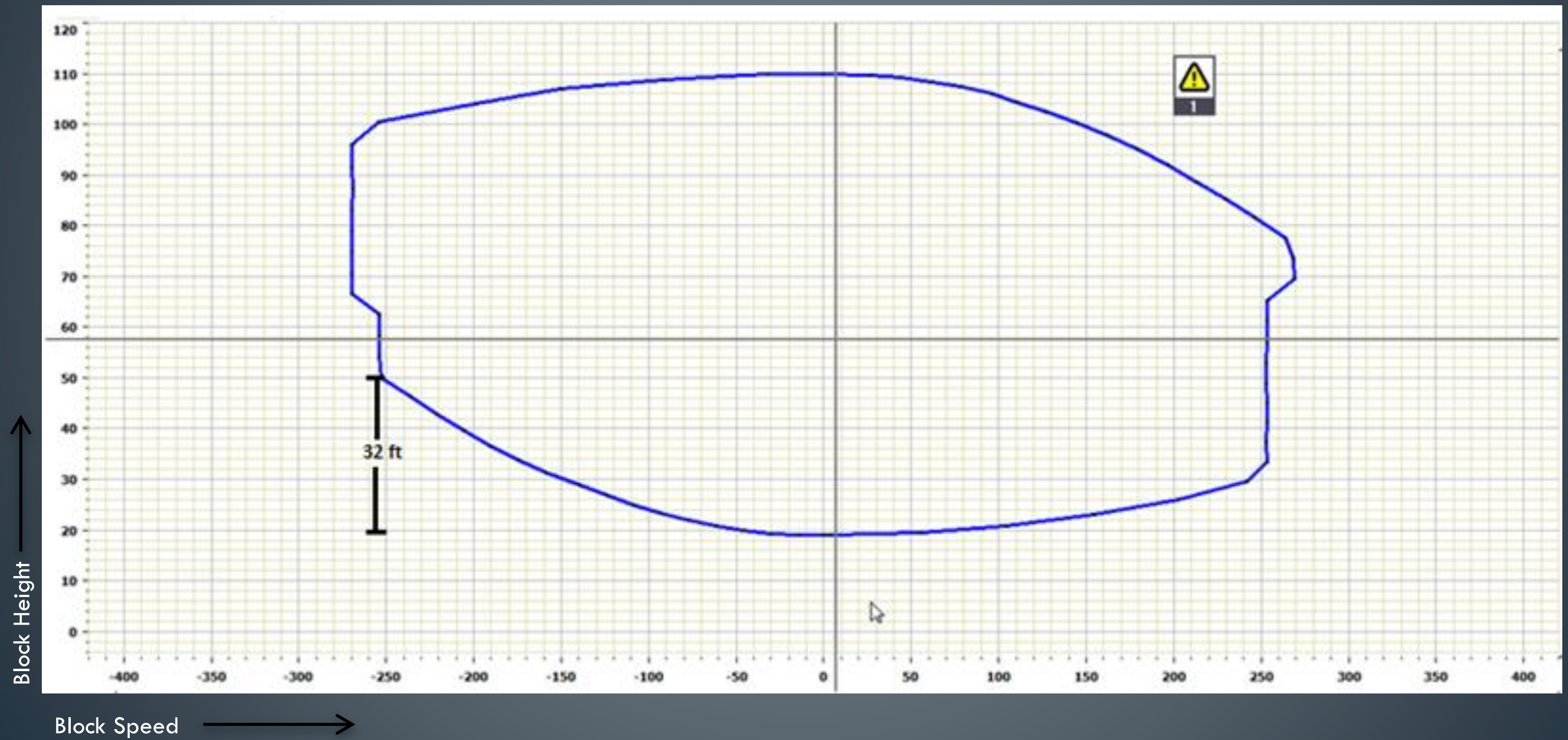
32 feet stopping distance – Before [Dynamic calculations depending on the layers]



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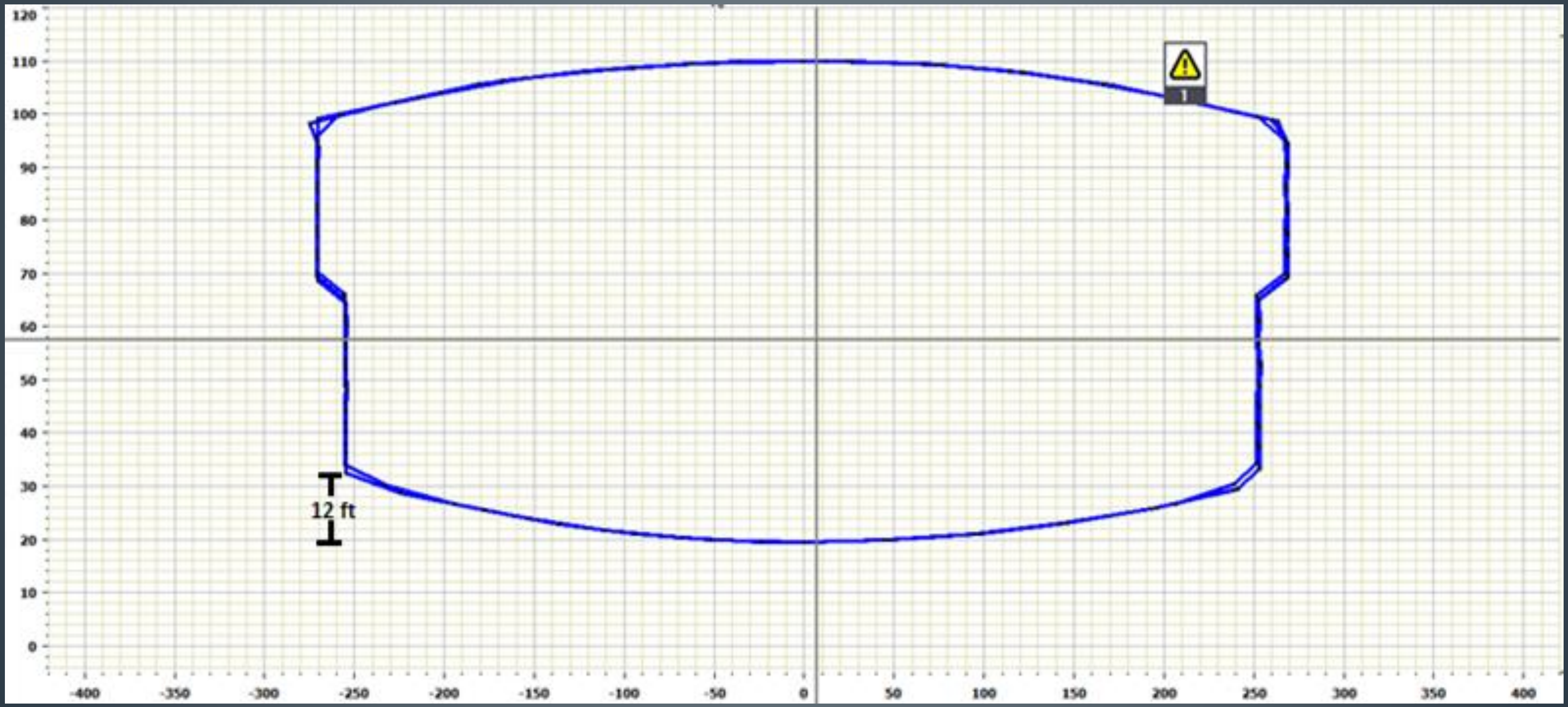
12 feet stopping distance – After [Dynamic calculations depending on the layers]



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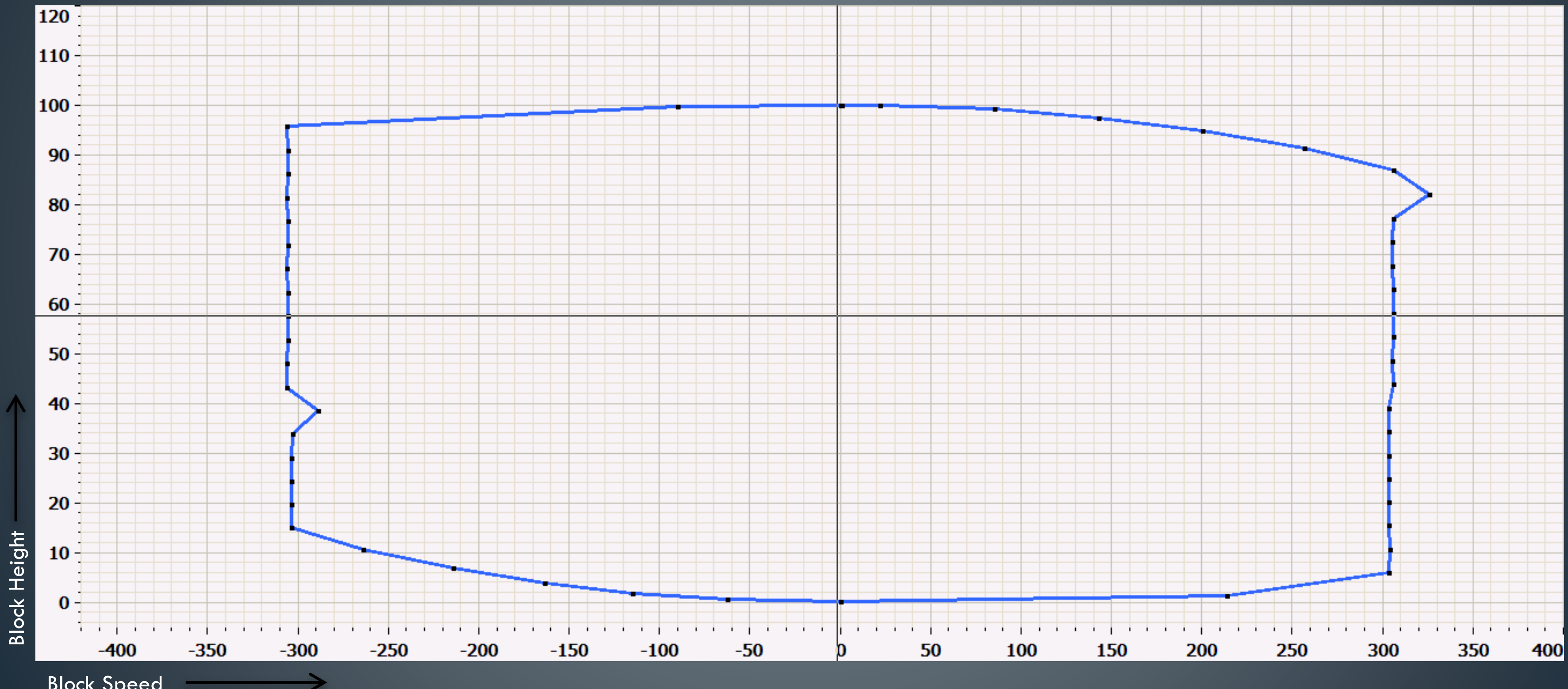
TARGET – After Optimization



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SUMMARY

- Optimize system performance
  - Developed in a single environment
  - No cosimulation
- Find problems before building hardware using HIL
- Discover integration problems using simulation
  - No cosimulation
- Create accurate, reusable plant models quickly and easily.
- Robust Control.