HUSCO

Machine Control - Automation of functions on the Machine

INTERNATIONAL FLUID POWER EXPO
MARCH 10-14, 2020
LAS VEGAS, NV, USA

AGENDA & INTRODUCTIONS

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Control of an Excavator
Project scope
Challenges
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Wrap up

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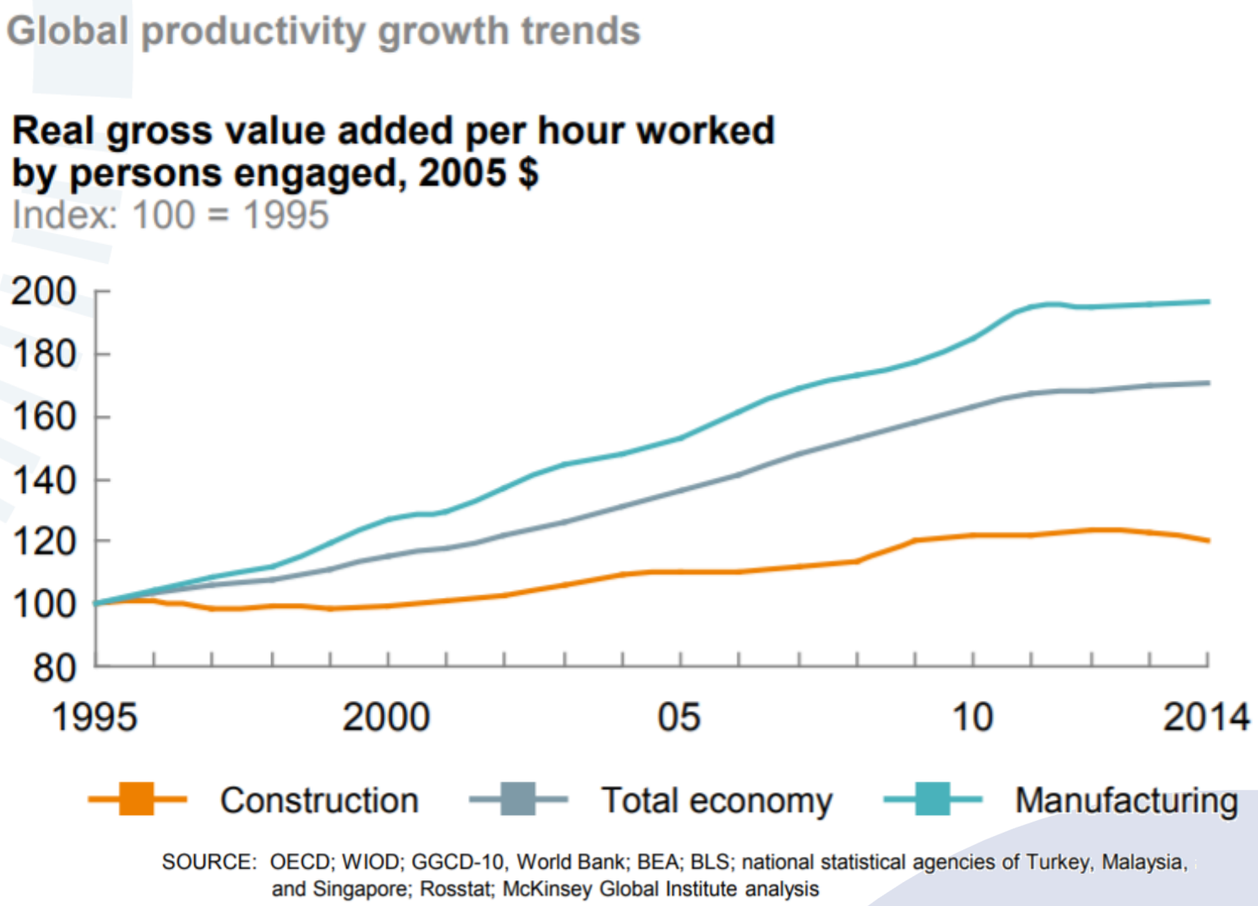
HUSCO

- Design and manufacture hydraulic components & systems
- 6 global manufacturing sites, worldwide engineering team
- 400+ degreed engineers
- Family owned and managed business
- Considered an extension to customer engineering groups
- Serves the automotive, construction, agriculture, and material handling markets

PROBLEM STATEMENT

The Opportunity for Productivity in Construction

Anemic gains in construction productivity = investment scope



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The Opportunity for Productivity in Construction

Anemic gains in construction productivity = investment scope

Reduction in skilled labor

Source: The Association of General Contractors of America

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The Opportunity for Productivity in Construction

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Increased pressure on capital utilization

Source: McKinsey & Company - Infrastructure productivity: How to save $1 trillion a year

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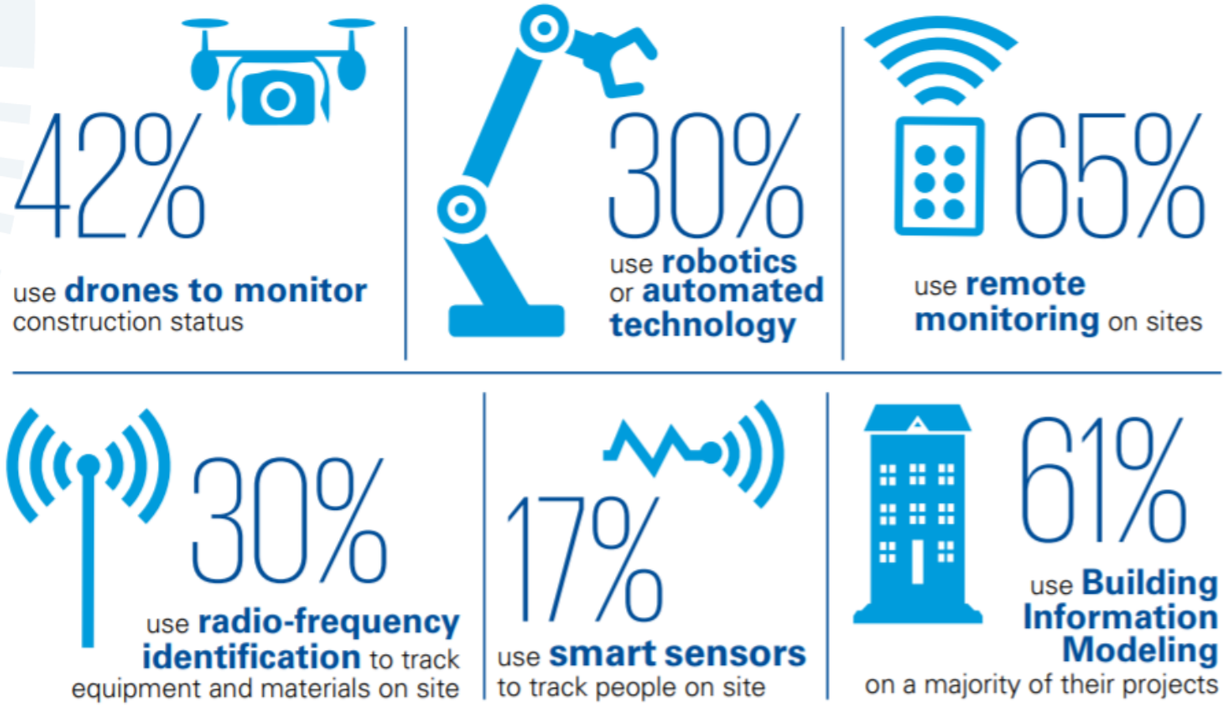
Increased pressure on capital utilization

Greater acceptance of technology on the worksite



Source: Global Construction Survey 2016 | Building a technology advantage
2016 KPMG International Cooperative ("KPMG International")

PROBLEM STATEMENT

The Opportunity for Productivity in Construction

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Increased pressure on capital utilization

Greater acceptance of technology on the worksite

Control of motor graders & dozers

CONTROL OF AN EXCAVATOR

PROJECT SCOPE

Electro-hydraulic control of any pilot operated excavator

Aim:

Fit system to a standard excavator to enable automated digital control

Deliverables:

1. Safety
2. Sub-system enhancing existing hydraulic circuit
3. Full speed automated grade at ±25mm tolerance

TEST MACHINE
21t standard excavator

4 years old

~4000 hours

Negative Control Hydraulic System

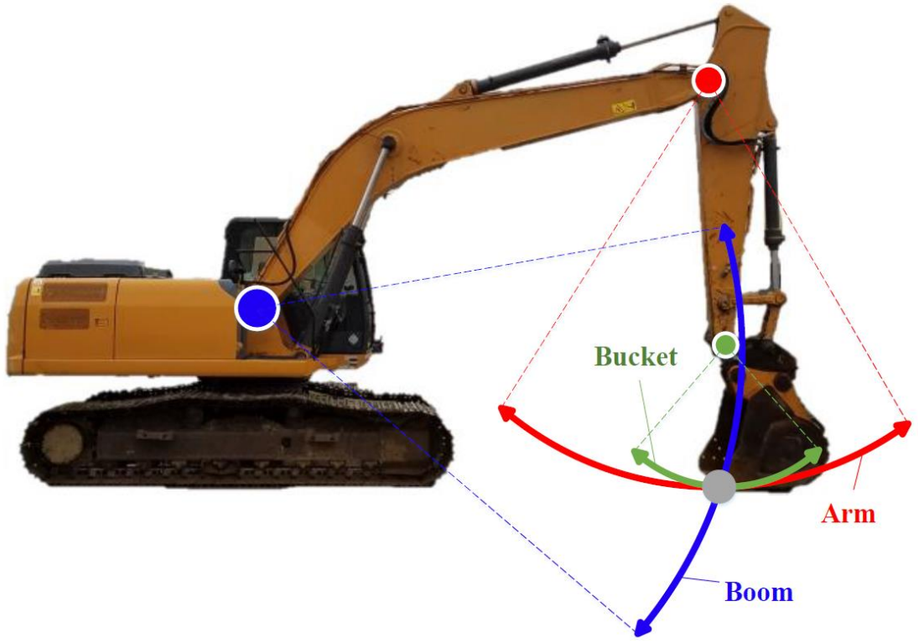
CONTROL - PATH PLANNING

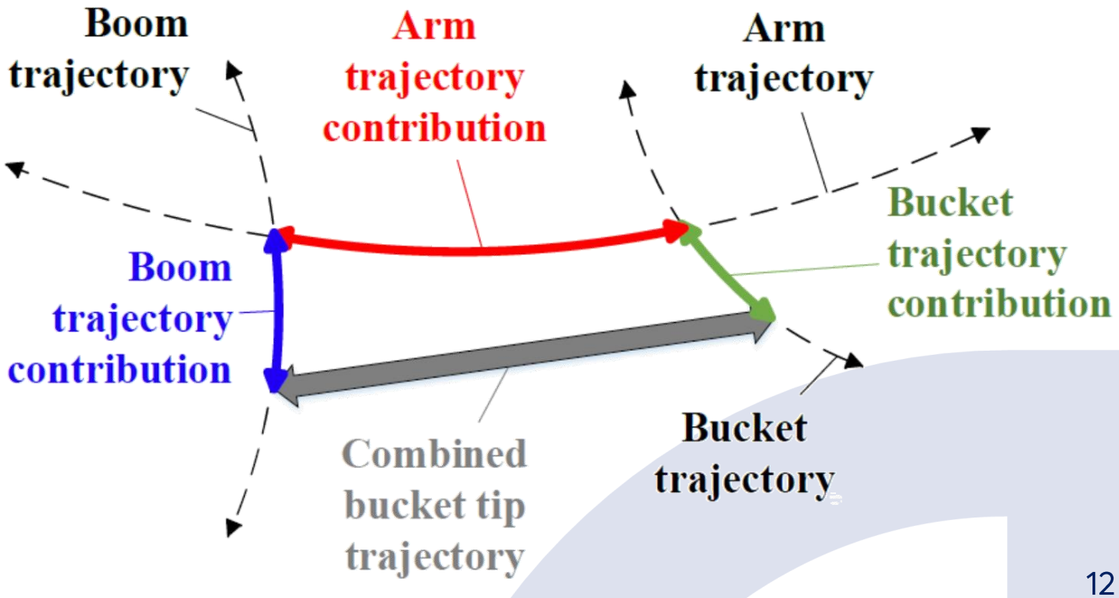
How to achieve robot type kinematic control?

Robotic end effector control is a mature

Robots have been developed for autonomous control using servo-actuators

Mobile equipment has been developed for human control using hydraulic actuators



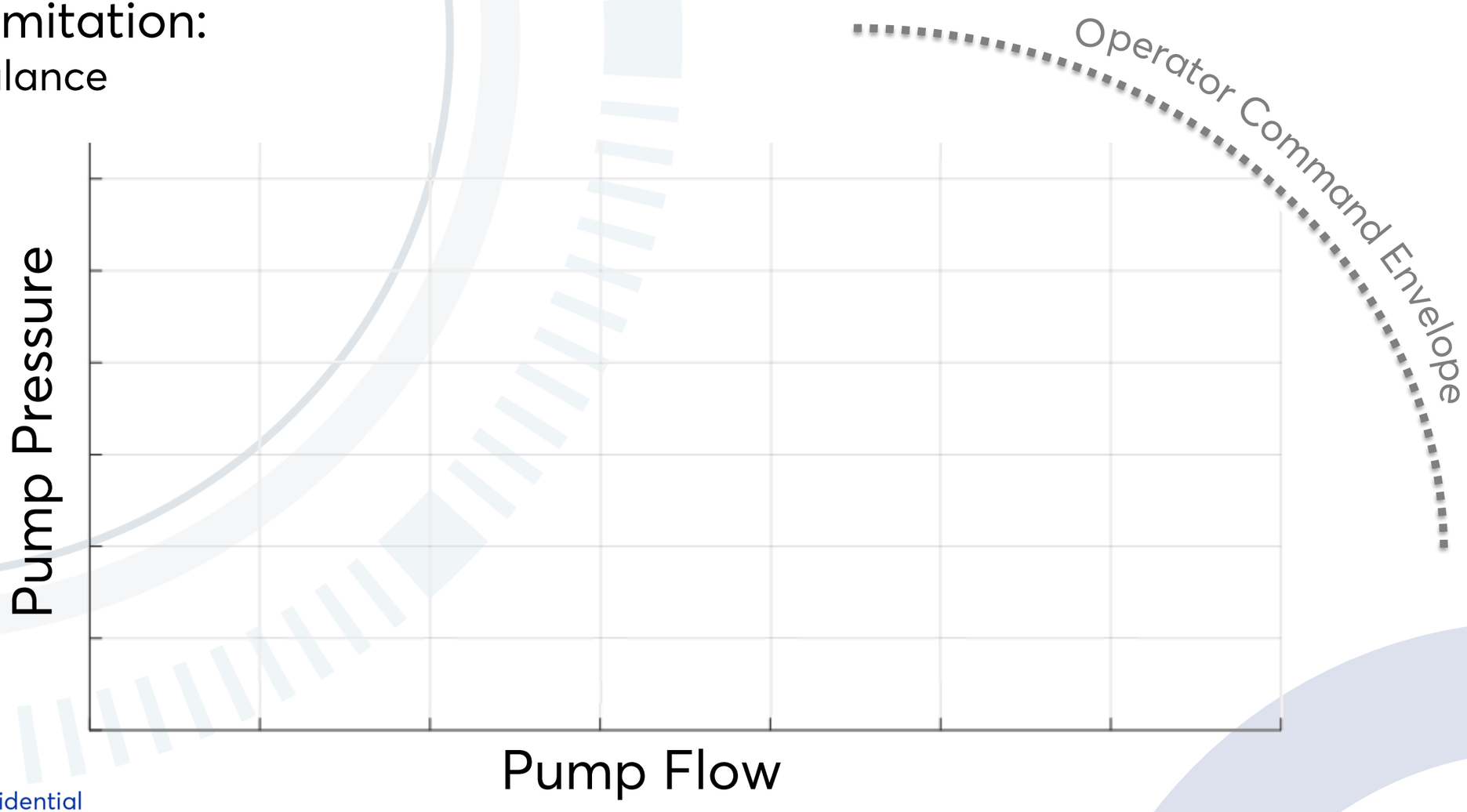


CHALLENGES

Controlling an Excavator – Variation in Command to Response

Machine limitation:

Constant balance



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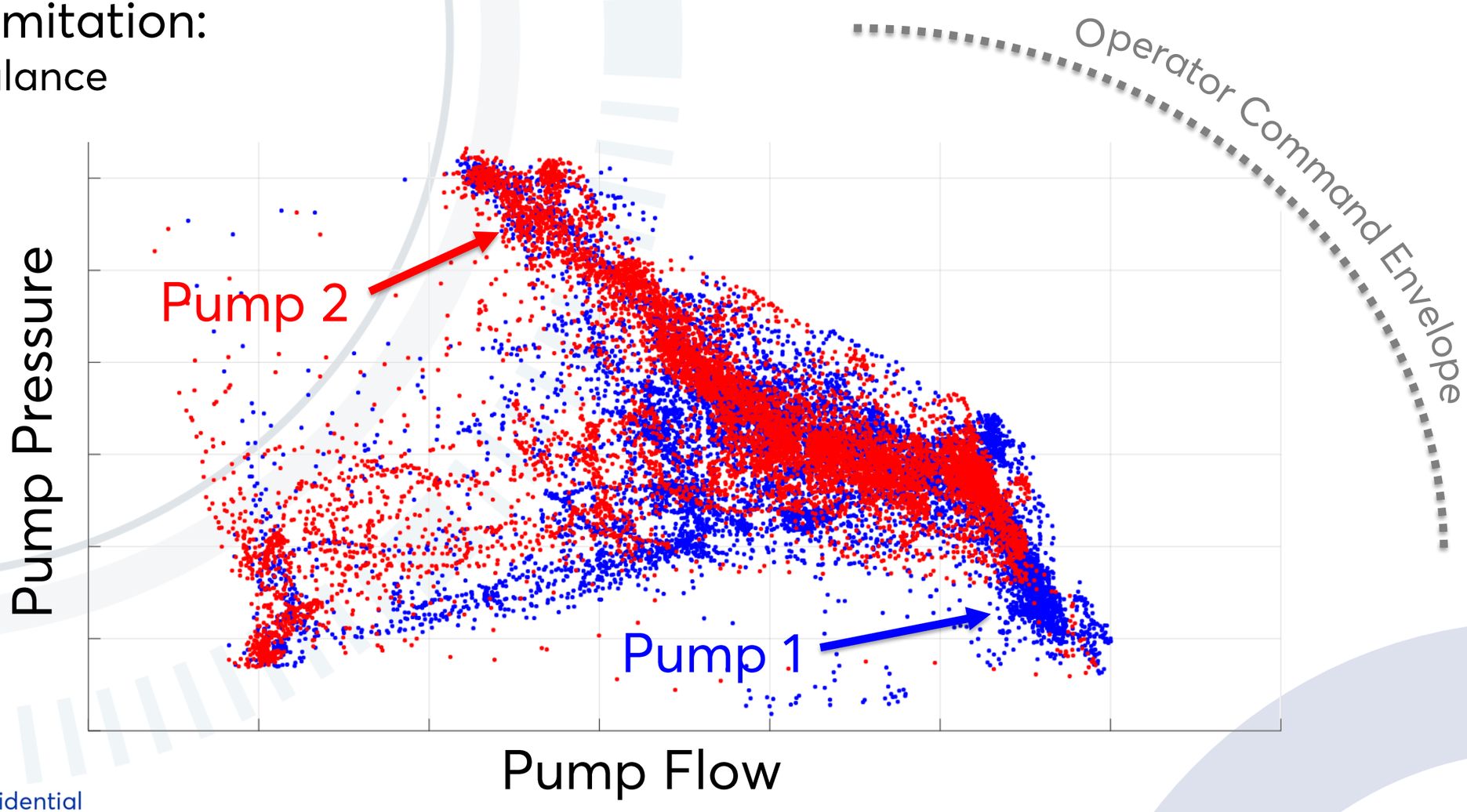

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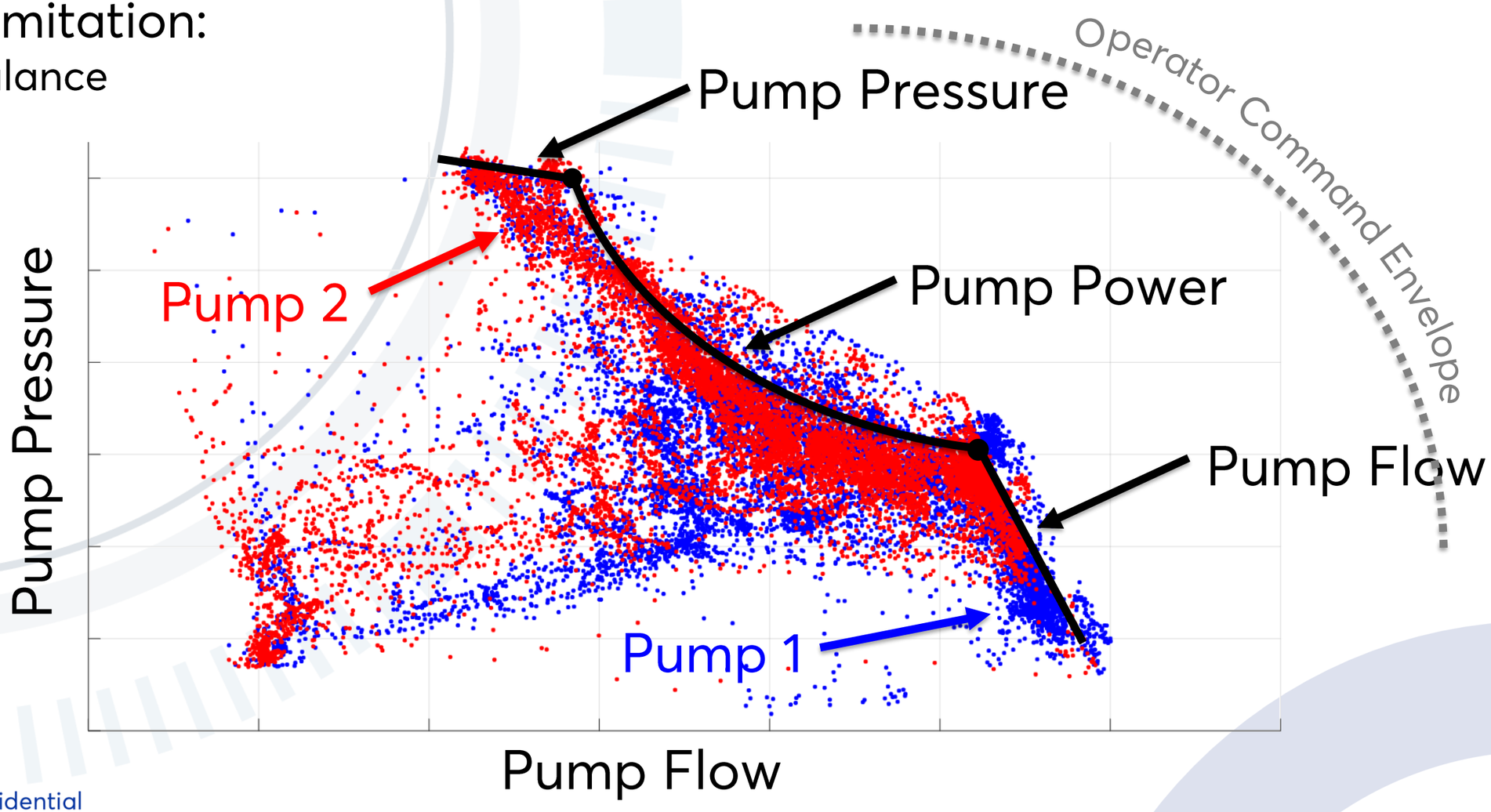
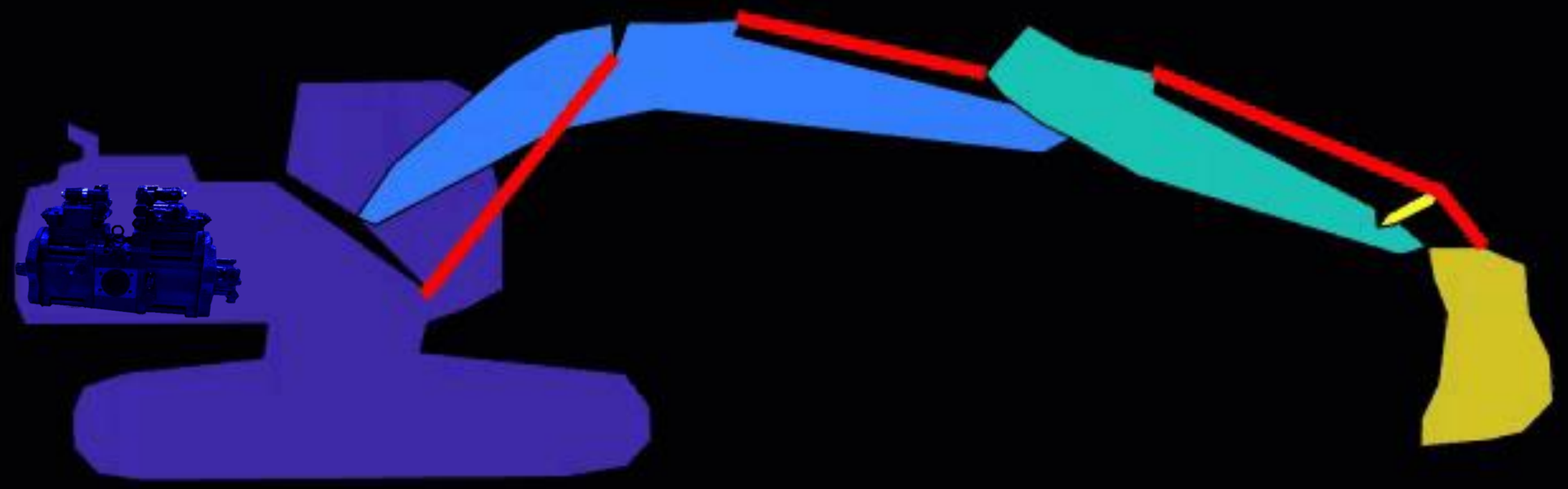


CHALLENGES

Controlling an Excavator – Variation in Command to Response

Less pumps than functions:

All functions interact



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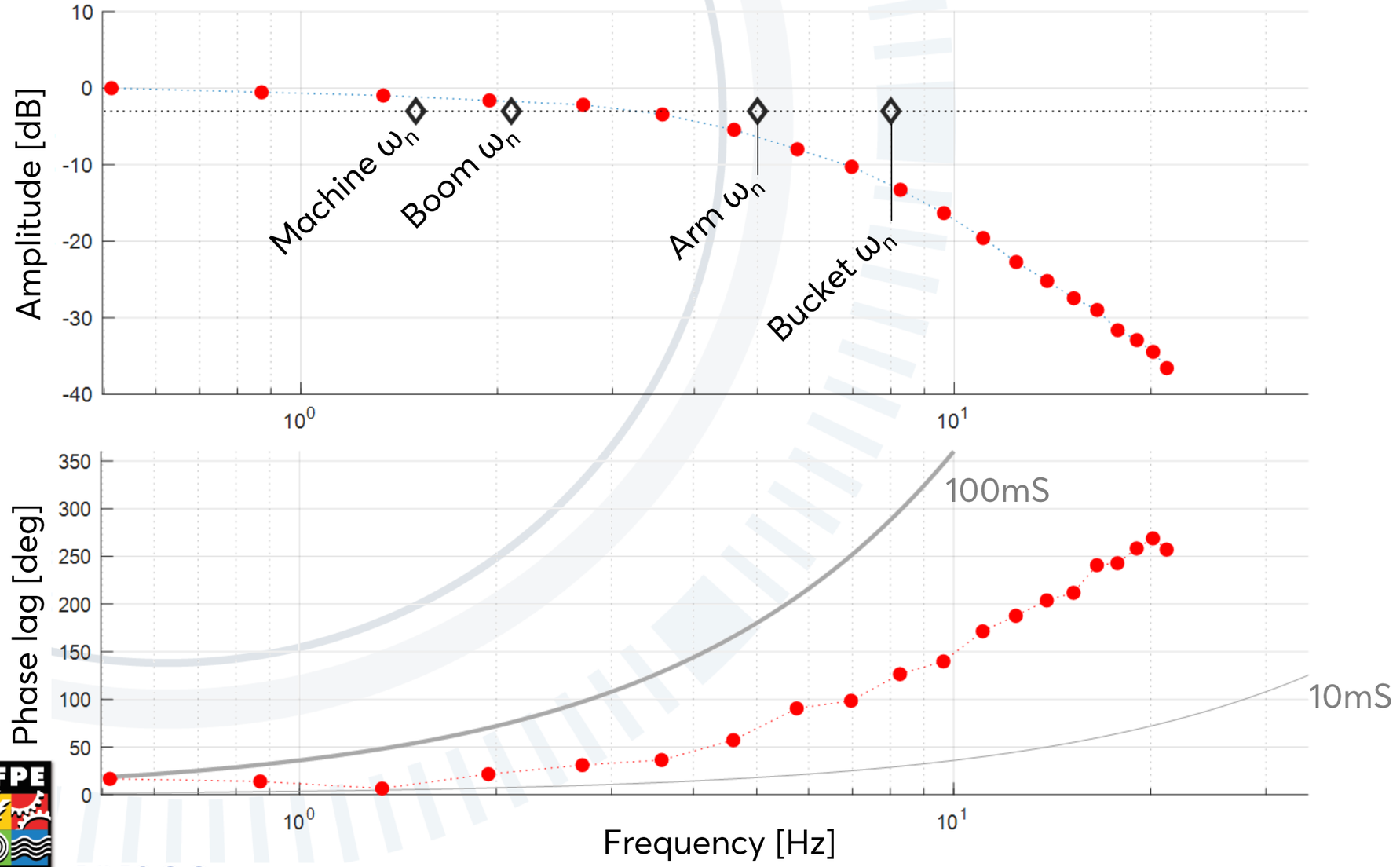


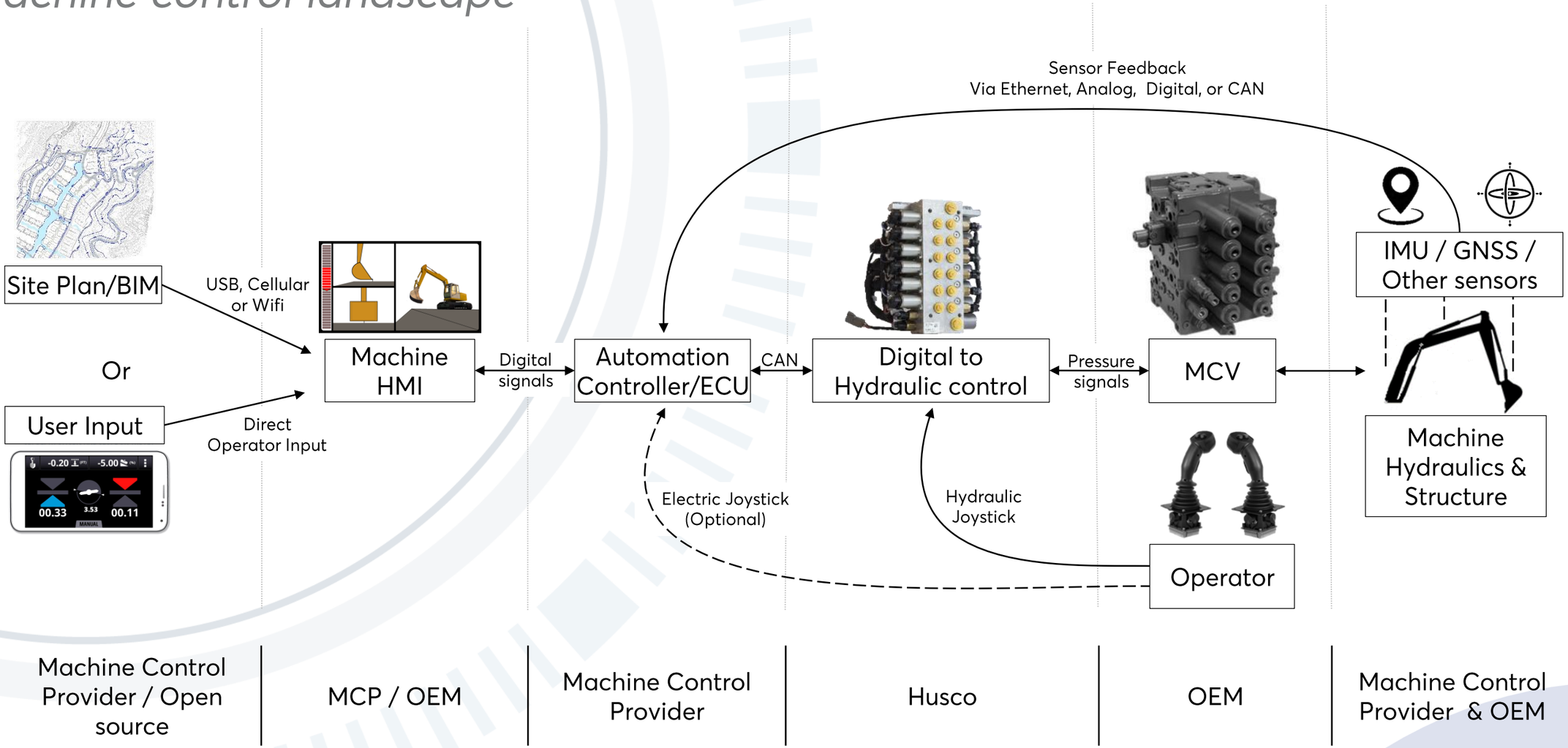
- Conventional mobile hydraulic hardware

EXACTO
Complete Integrated System

- 3 function control
- Safety logic circuit
- Operator and main control valve feedback
- From “operator only” to full automated control
- High performance digital to hydraulic components
- Integrated controller & work function algorithms

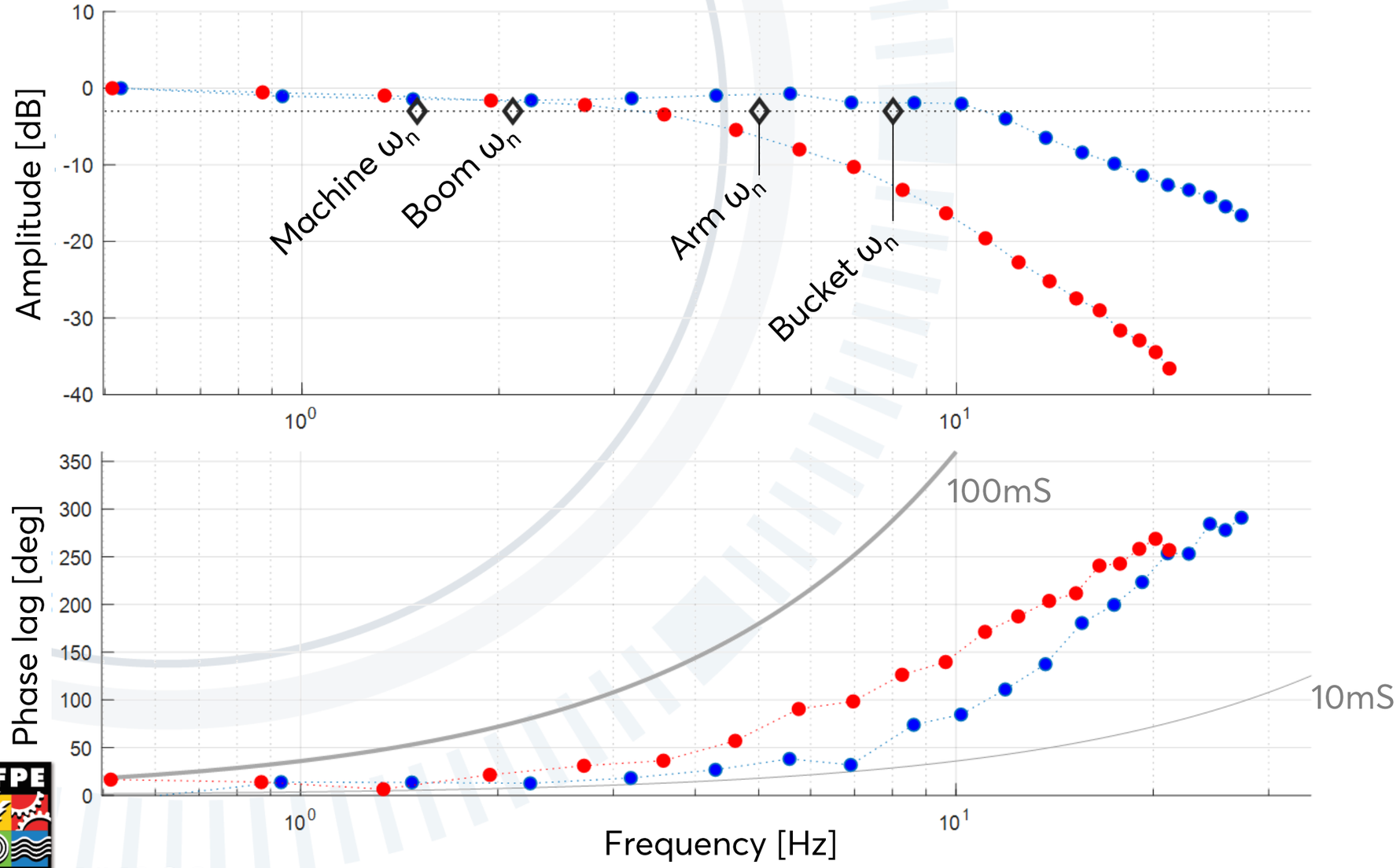
EXACTO

Machine control landscape



THE RESULTS

High Fidelity Hydraulic System

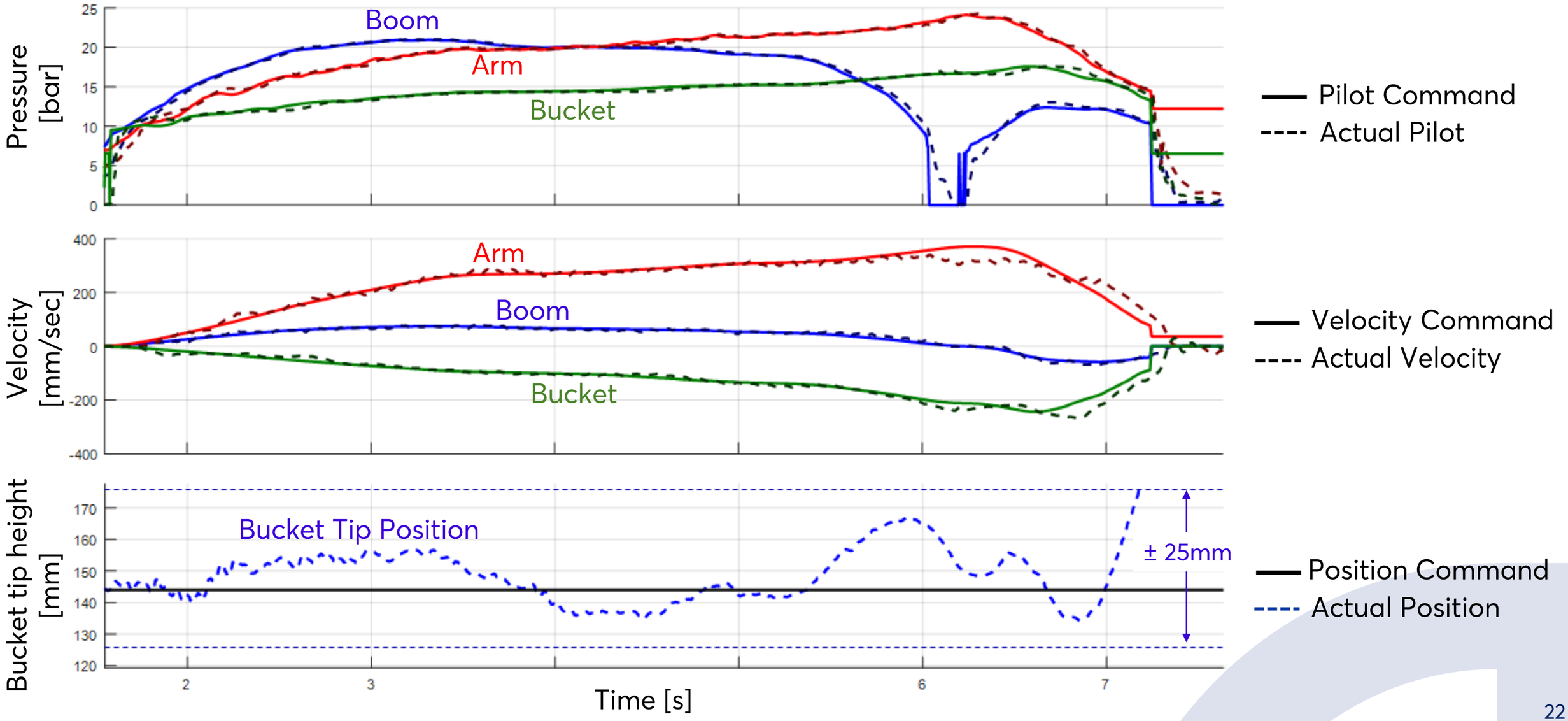


- Exacto System
- Conventional mobile hydraulic hardware

THE RESULTS

THE RESULTS

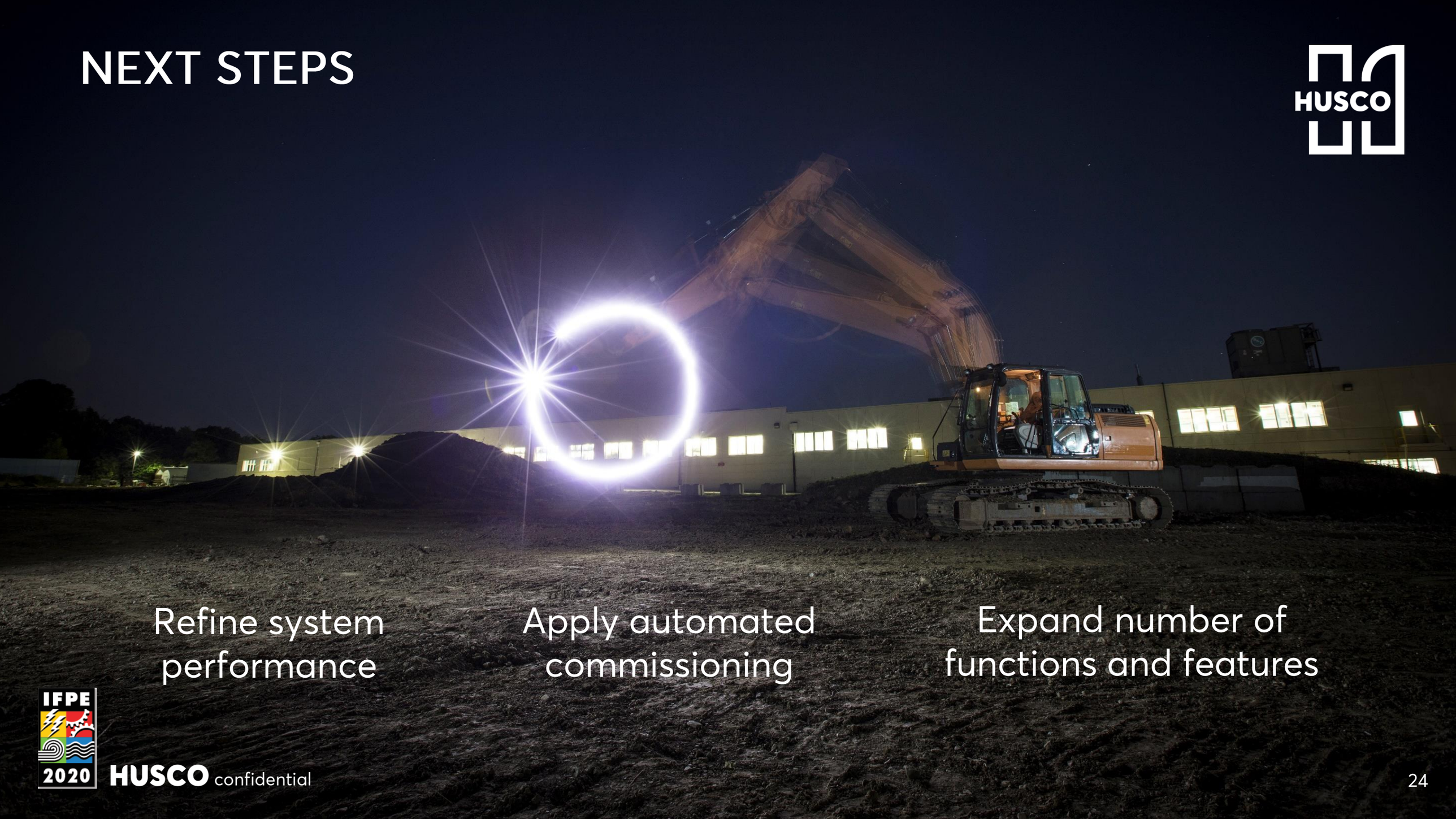
Pressure, Velocity & Position



THE RESULTS

5m in 5.6s @ ±25mm

NEXT STEPS



Refine system performance

Apply automated commissioning

Expand number of functions and features

Thank you for listening.
We welcome any questions

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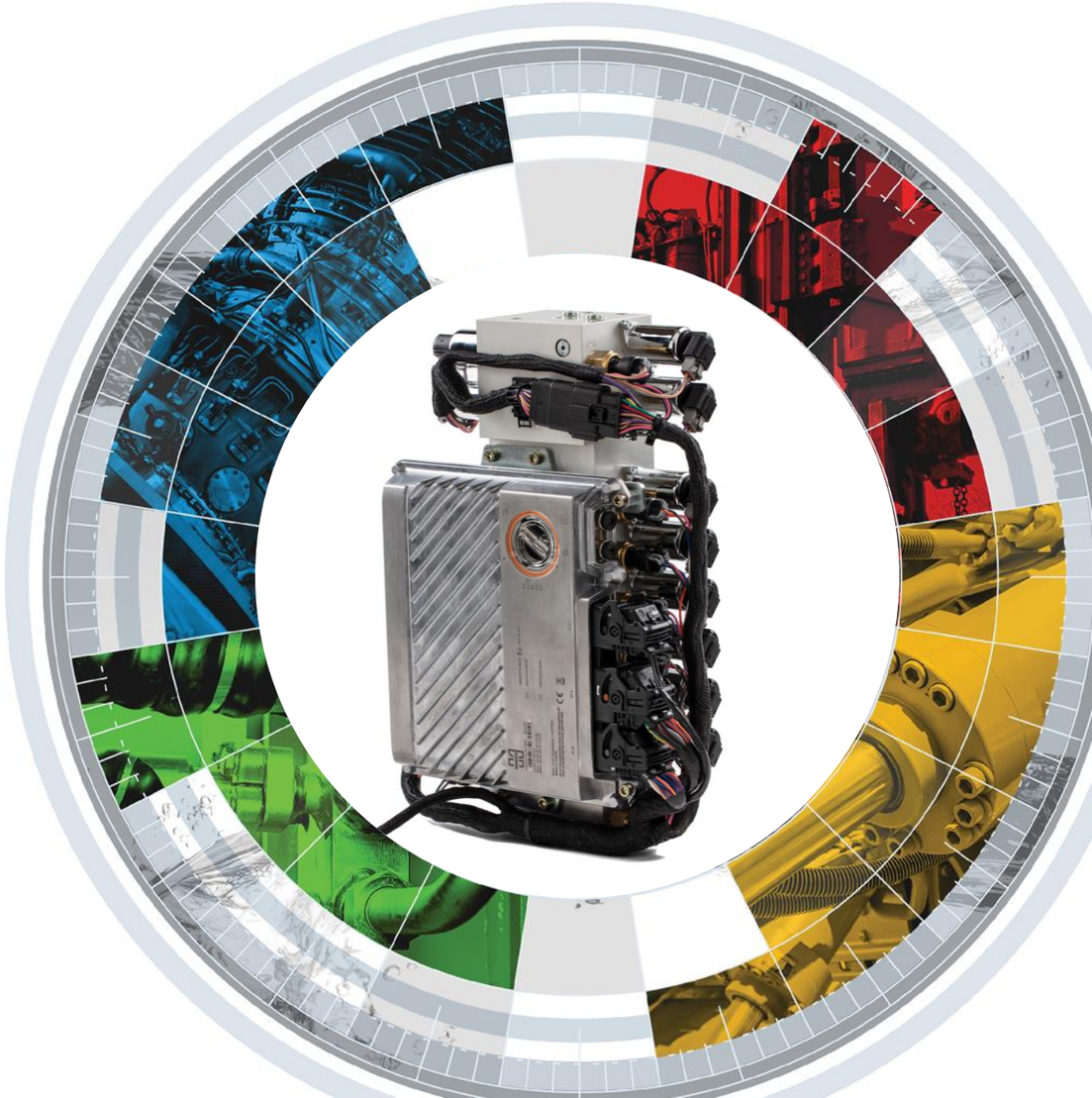

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