



PUSHING THE ACHIEVABLE ENVELOPE IN MODERN TANK DESIGN

MANUFACTURING WITH ADVANCED
ROBOTICS AND ARTIFICIAL INTELLIGENCE



THE PROBLEM WITH TRADITIONAL MANUFACTURING

- Manufacturing is inflexible, hyper complex and expensive
- Every new physical product requires a custom factory setup

WE EXPERIENCED THIS FIRST-HAND AT SPACEX

- In 24 years only two rocket families were created
- Factories had to be uniquely designed for each rocket, hindering product evolution and innovation

FALCON 9

STARSHIP



/ ENABLERS

WE TRANSFORM RAW MATERIALS AND COMPLEX DESIGNS INTO TANGIBLE REALITY – NO HUMAN INTERVENTION REQUIRED



ARTIFICIAL INTELLIGENCE



ROBOTICS



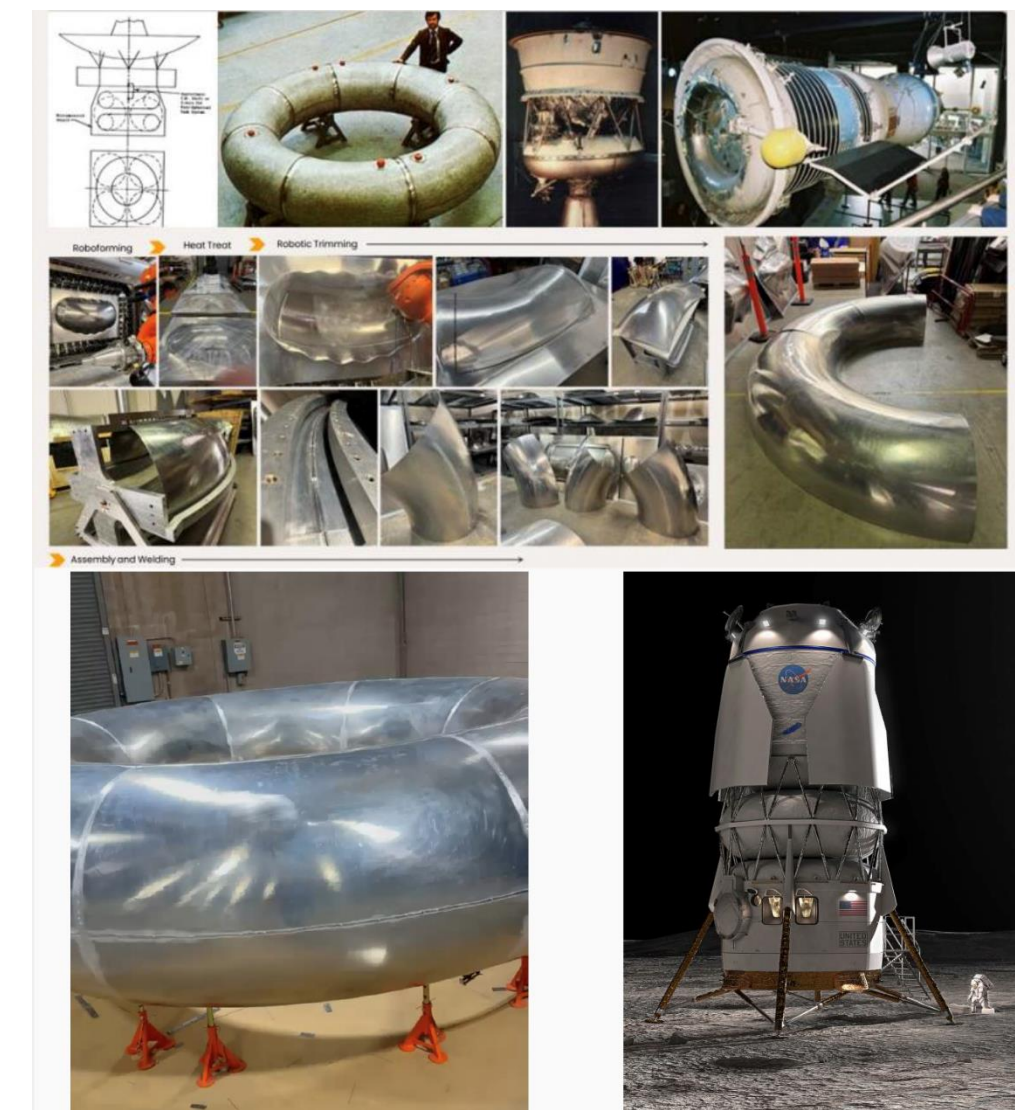
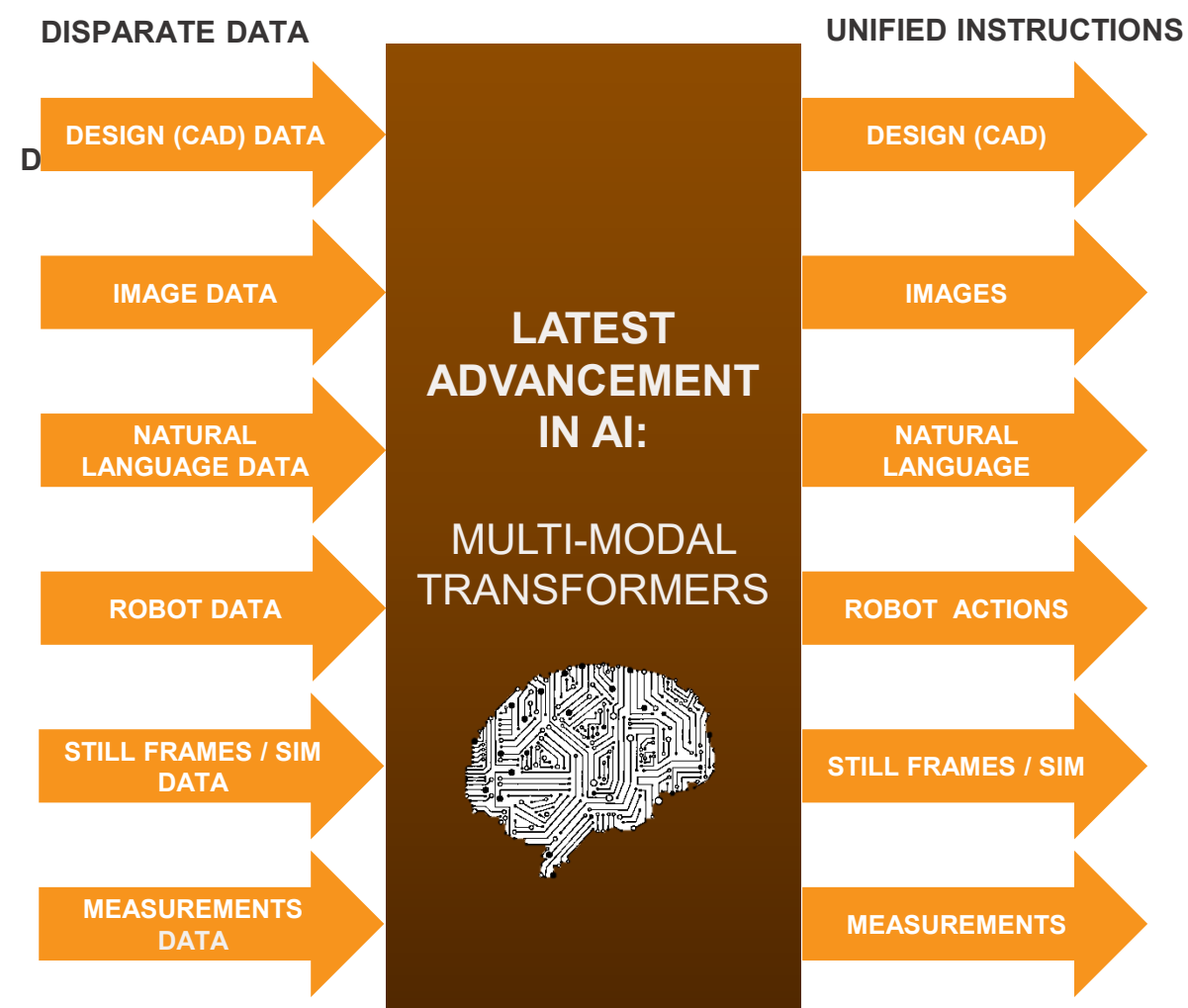
PHYSICAL PRODUCTS

WITH NEAR-HUMAN INTELLIGENCE AND AGILITY, WE TRANSFORM COMPLEX DESIGN INTENT INTO PRECISE MANUFACTURING STEPS AND PARAMETERS.

WITH HUMAN-LEVEL DEXTERITY AND SENSING, WE CAN EXECUTE EVERY MANUFACTURING STEP TO TURN DESIGN INTENT AND RAW MATERIALS INTO A FINISHED PRODUCT.

YOU GET PHYSICAL PRODUCTS FASTER AND CHEAPER THAN EVER, WITH BETTER PERFORMANCE THAN TRADITIONAL PARTS AND YOU CAN EVEN ENABLE PROCESSES THAT WEREN'T POSSIBLE BEFORE.

“MAKE ME A HYPERSONIC AIRPLANE PANEL”





SOLUTION: FLEXIBLE FACTORIES IN AMERICA POWERED BY ROBOCRAFTSMAN



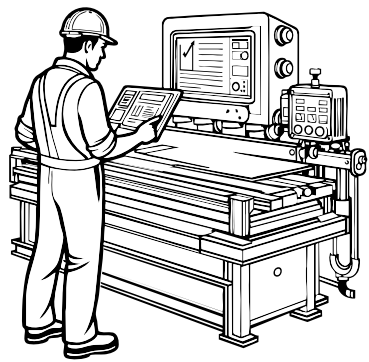
THE **ROBOCRAFTSMAN™** IS LAYING THE
GROUNDWORK FOR TOMORROW'S
FLEXIBLE FACTORIES



THE ROADMAP TO /SCALABLE AND AGILE FACTORIES



MACHINA LABS

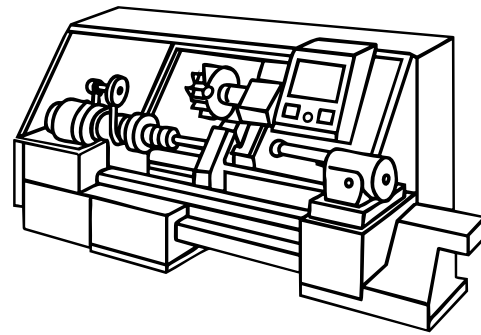


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NO AUTOMATION NO AUTONOMY

Operator controls motion and settings.

Rigid factories relying on human skill.

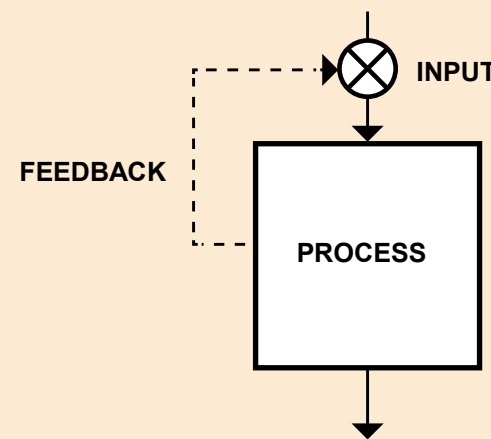


01

OPEN-LOOP MOTION

Computer Numerical Control (CNC) of motion for primary operation.

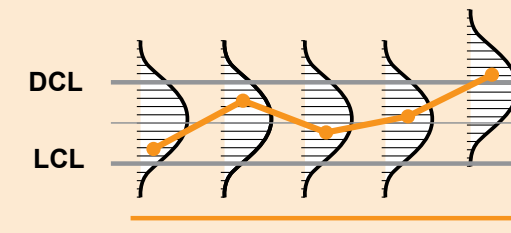
Rigid factories relying on dumb machines.



02

CLOSED-LOOP CONTROL

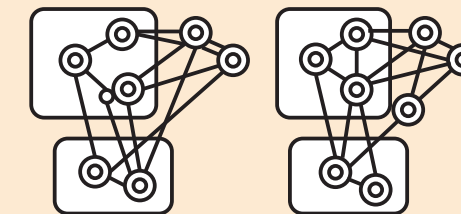
Key component metrics are sensed during the process, and control algorithms minimize errors.



03

PROCESS SIMULATION & IN- SITU CORRECTION

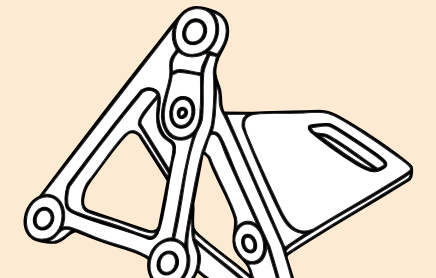
Experience or physics-based simulation gives expected outcomes, and process strategy may be modified.



04

AUTOMATED HYBRID PROCESS EXECUTION

Multiple fully automated processes are used, with automated hand-offs between them.



APPLICATION COMPLETE

05

AUTOMATED DESIGN & NEGOTIATION

The system considers multiple process paths and trade-offs, including performance, price, tolerances, and lead time.

UNITARY PROCESS

MULTI-PROCESS & SCALABLE

BENEFITS BY APPLICATION

/AEROSPACE & DEFENSE



AERO STRUCTURES

- RAPID ITERATION FOR AEROSPACE
- COST & MATERIAL EFFICIENCY
- ON-DEMAND MANUFACTURING FOR COMPLEX PARTS



MISSILE STRUCTURES

- ACCELERATED DEVELOPMENT
- TOOLING-FREE ADAPTABILITY
- AUTOMATED PRECISION & EFFICIENCY



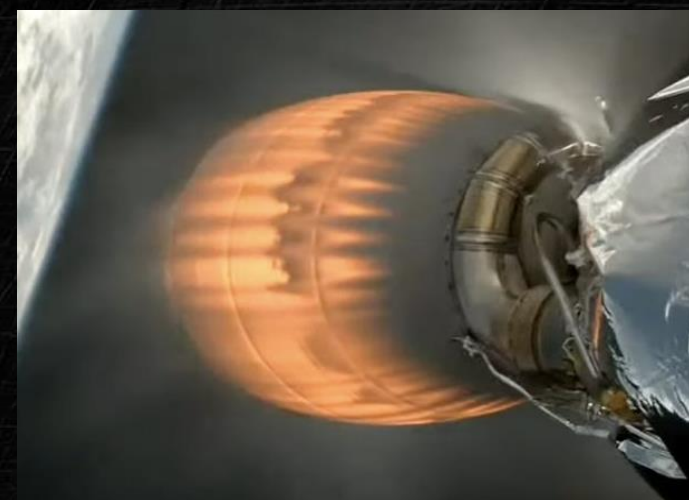
HYPERSONICS

- HIGH-PERFORMANCE MATERIALS AT SPEED
- FAST DESIGN ITERATION UNDER EXTREME DEMANDS
- ADAPTIVE GEOMETRY AND PRECISION



COPV's AND TOROIDAL TANKS

- SEAMLESS METALLIC LINERS
- OPTIMIZED SHAPES FOR VOLUME EFFICIENCY
- LIGHTWEIGHT, HIGH-STRENGTH MATERIALS



HIGH TEMP NOZZLES

- HIGH-TEMPERATURE METAL FORMING
- RAPID PROTOTYPING FOR ENGINE DEVELOPMENT
- OPTIMIZED THIN-WALLED, HIGH-STRENGTH STRUCTURES



GORE SEGMENTED DOMES

- SCALABLE MANUFACTURING OF CURVED STRUCTURES
- SEAMLESS INTEGRATION INTO PROPELLANT TANKS
- ADAPTABLE TO VARIOUS ALLOYS

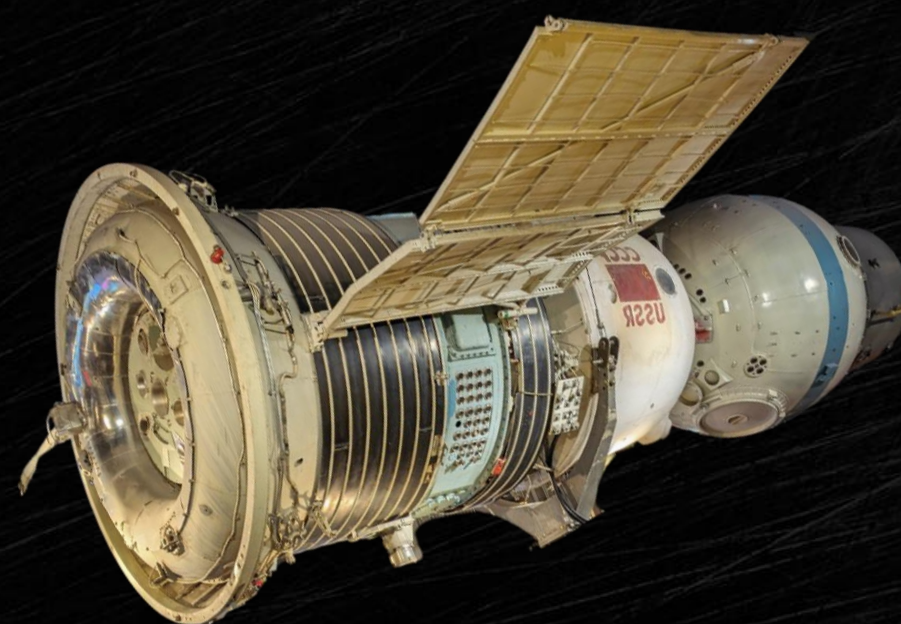


IN SPACE APPLICATIONS – TORIODAL TANKS

⌚ MANUFACTURING COMPLEX STRUCTURES → **75% FASTER + 85% COST REDUCTION**

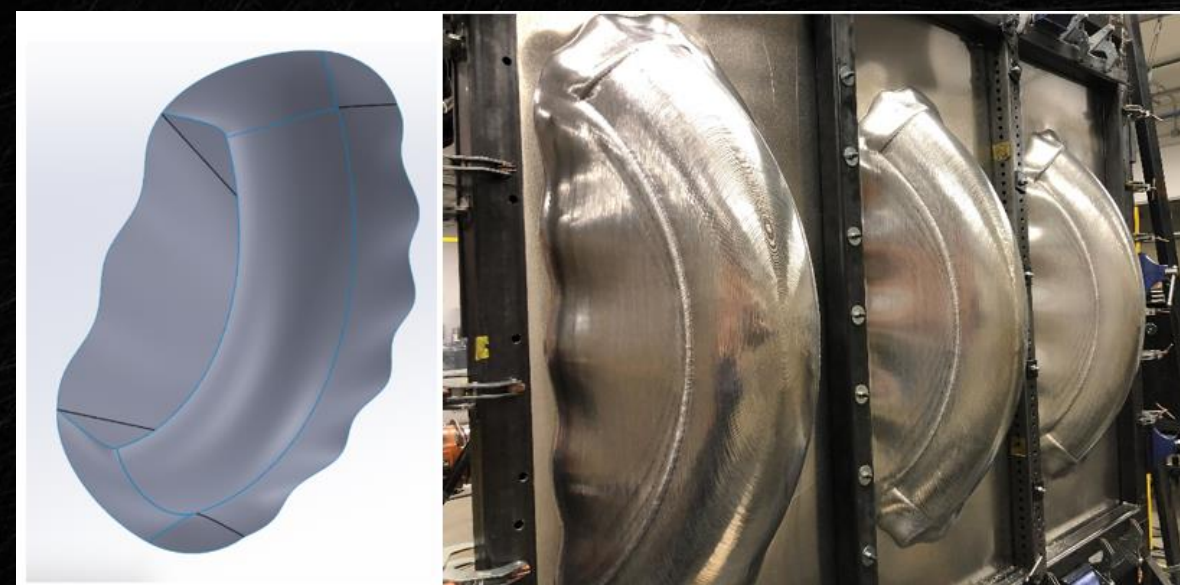
CHALLENGE

- NASA, ESA, AND THE SOVIET SPACE PROGRAM HAVE LONG EXPLORED TOROIDAL FUEL TANKS FOR SPACECRAFT AND LUNAR LANDERS.
- THE EXTREME COMPLEXITY OF MANUFACTURING TOROIDAL TANKS LED NASA TO ABANDON THE CONCEPT DUE TO THE SKILLED LABOR AND SPECIALIZED TOOLING REQUIRED.



SOLUTION

- MACHINA LABS' ROBOCRAFTSMAN ENABLES FAST, DIE-FREE SHEET METAL FORMING FOR GROUND AND SPACE APPLICATIONS.
- THE MANUFACTURING PROCESS INCLUDED ROBOFORMING, ROBOSCANNING, ROBOTRIMMING AND DRILLING, AND THE ASSEMBLY AND WELDING OF 32 DISTINCT PANELS WITH 2 UNIQUE GEOMETRIES.



RESULTS

- COMPLETED PHASE I AND PHASE II SBIRS AND SUCCESSFULLY PROTOTYPED SUB AND FULL-SCALE TOROIDAL TANKS. ADVANCED TO PHASE III COMMERCIALIZATION.
- REVIVED A NASA TANK DESIGN AND SHOWCASED HOW AI-DRIVEN ROBOTIC MANUFACTURING ENABLES FASTER, CHEAPER, AND MORE AGILE PRODUCTION FOR SPACE, AEROSPACE, AND DEFENSE.





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THANK YOU

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