



MATLAB EXPO

Moonshots: How Engineers and Scientists Are Achieving the Impossible

Dr. Arun Mulpur, MathWorks





Courtesy of NASA



Courtesy of NASA



Courtesy of NASA

Moonshots Foster Emerging Technologies

Heat-resistant alloys



Courtesy of NASA

Fireproof fabrics



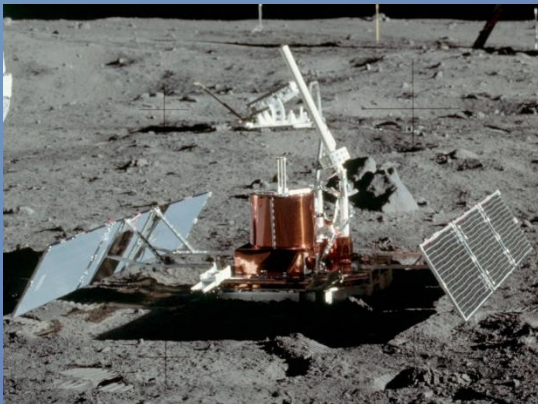
Courtesy of NASA

Freeze-dried foods



Photo by Jurvetson (flickr)
<https://creativecommons.org/licenses/by/2.0/>

Photovoltaic cells



Courtesy of NASA

Integrated circuits

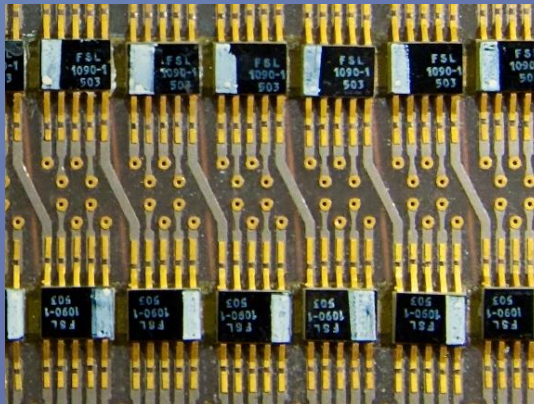


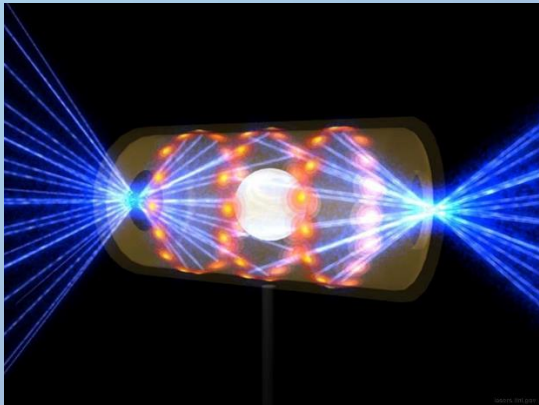
Photo by DDebold (flickr)
<https://creativecommons.org/licenses/by/2.0/>

Computers



Photo by Jurvetson (flickr)
<https://creativecommons.org/licenses/by/2.0/>

Moonshots: Projects with lofty and seemingly impossible goals



Moonshot: Unlimited Clean Energy

Global energy consumption will grow by almost 50% between 2020 and 2050

– **CNBC**



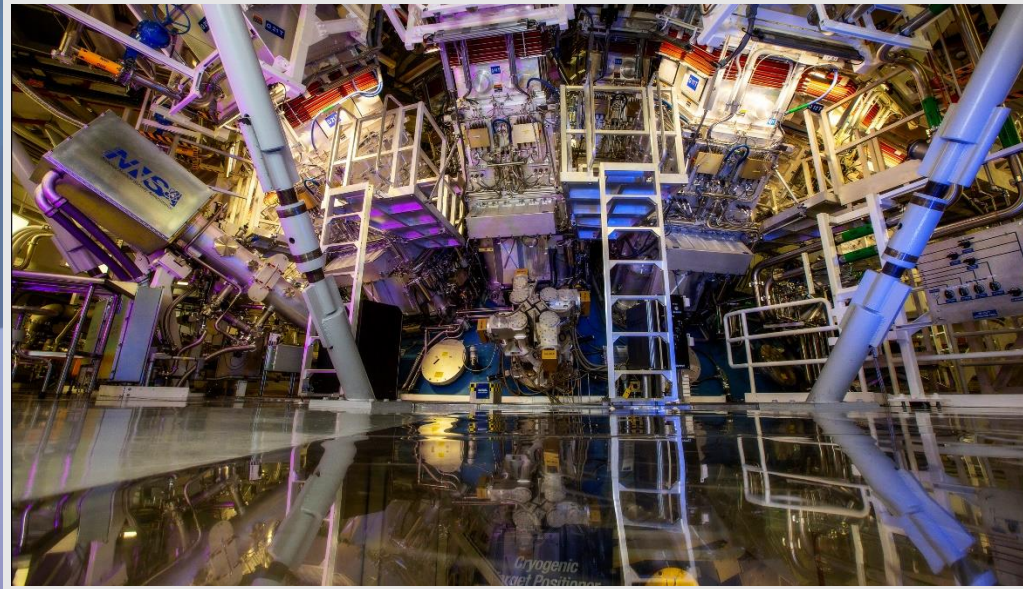


Moonshot: Unlimited Clean Energy



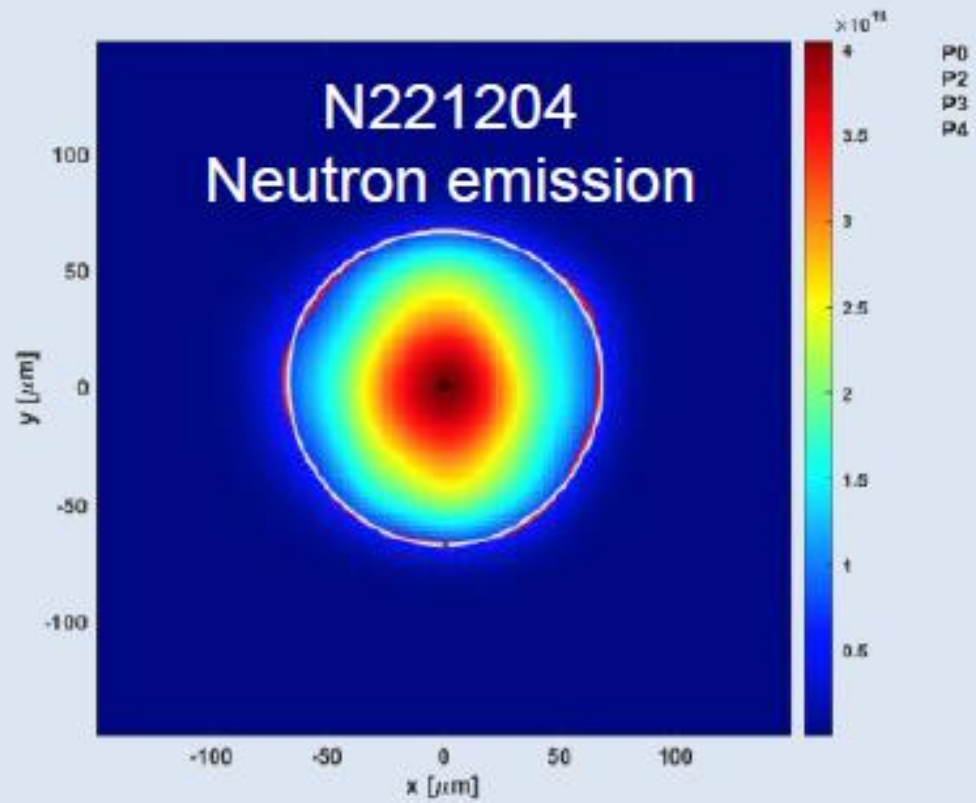
Scientists Achieve Nuclear Fusion Breakthrough With Blast of 192 Lasers

– *The New York Times*

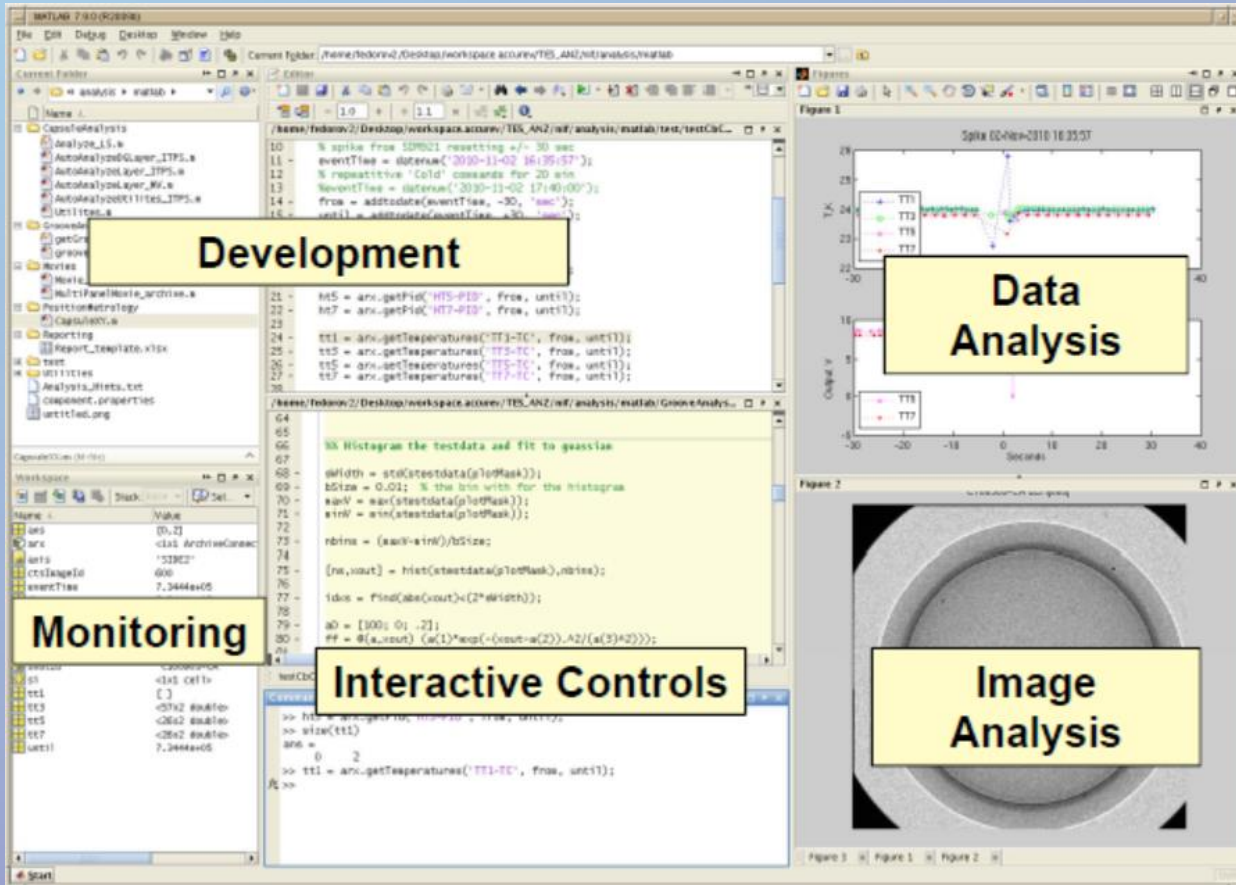


Courtesy of Lawrence Livermore National Laboratory

Fusion Breakthrough



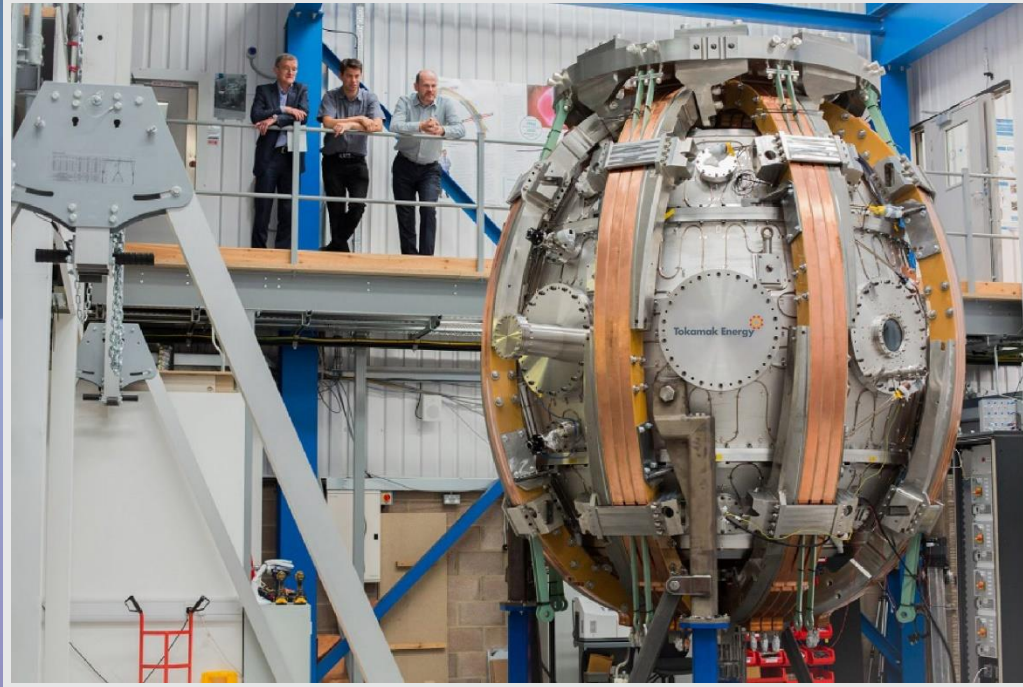
Fusion Breakthrough



Courtesy of Lawrence Livermore National Laboratory

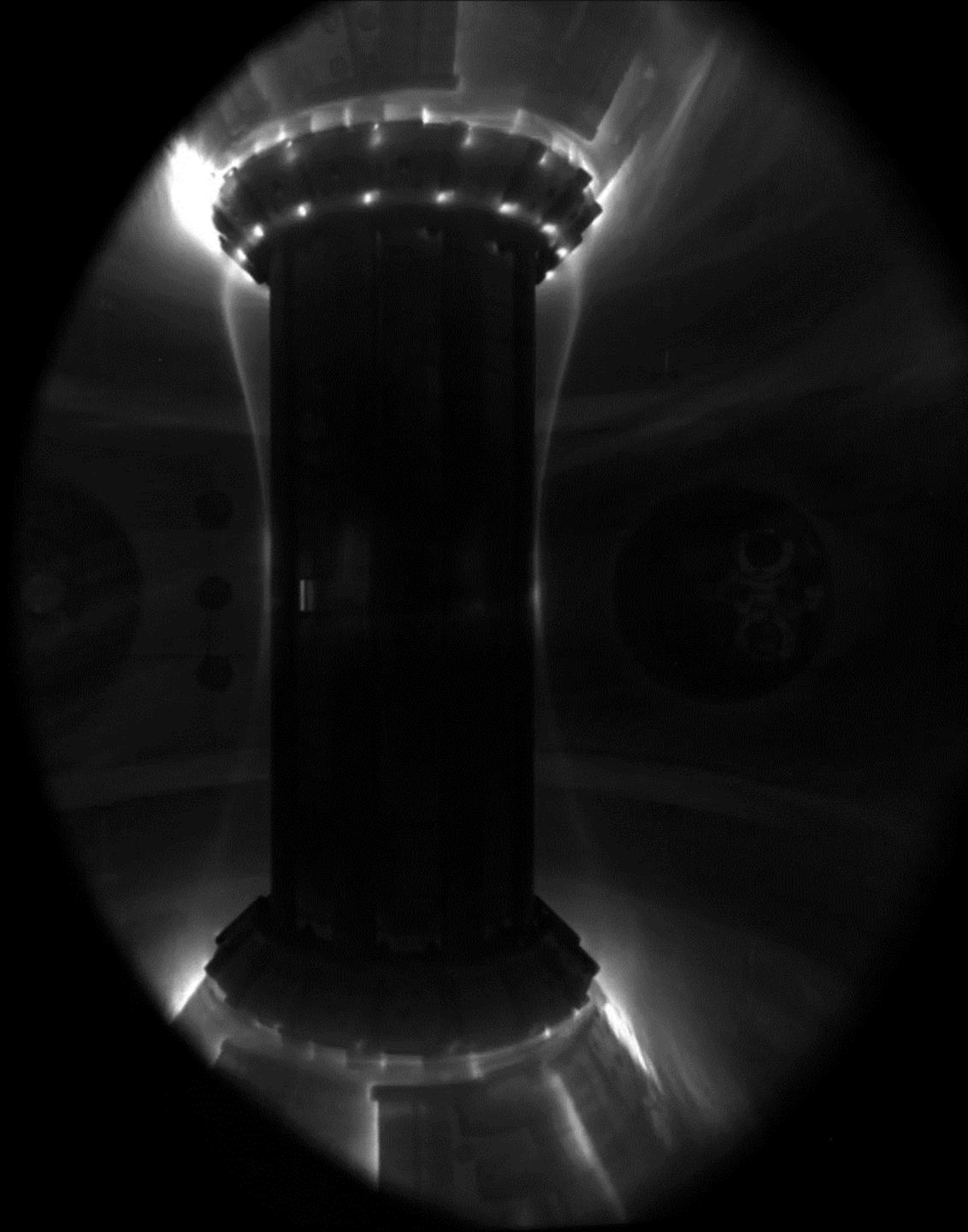
This Compact Tokamak Is on the Verge of Commercial Energy Production

– *Popular Mechanics*



Courtesy of Tokamak Energy

ST40 #10014



Achieving 100M° Celsius

Simulink and Simulink Coder for developing and deploying plasma control algorithms

MATLAB for real-time and post-pulse data analysis



Electrification

MASTER CLASS

Developing Electrified Propulsion Systems
for a Sustainable Future



Rahul Choudhary, MathWorks

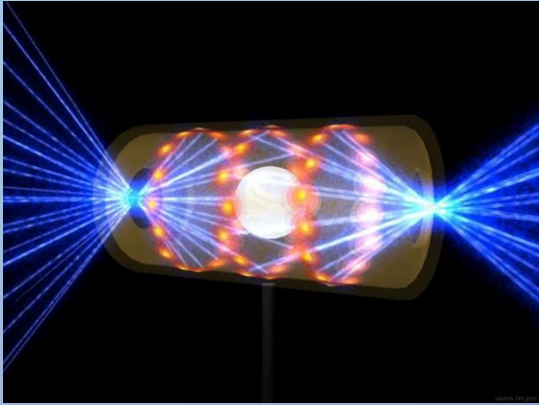


Ramanuja Jagannathan, MathWorks

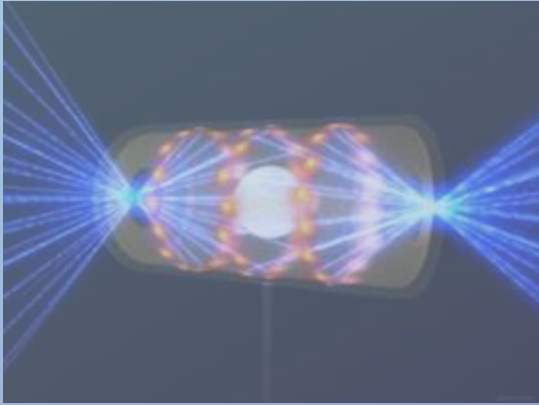
TECHNOLOGY SHOWCASE

Electrification:
From Prototyping to Production

Moonshots: Projects with lofty and seemingly impossible goals



Moonshots: Projects with lofty and seemingly impossible goals

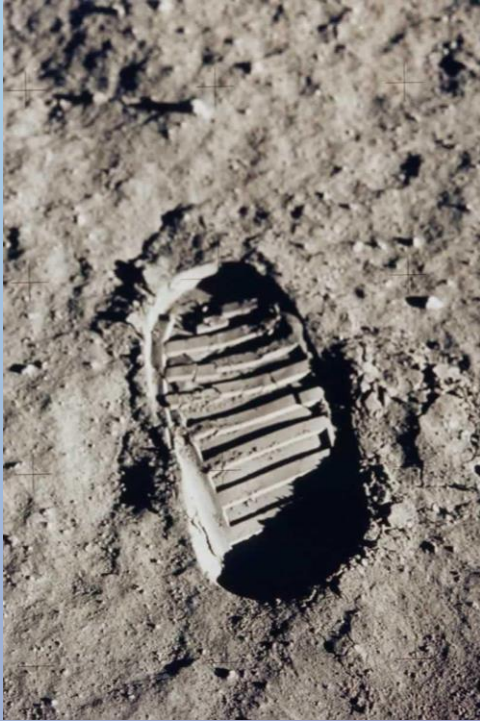




Moonshot: Improving Quality of Life through Healthcare



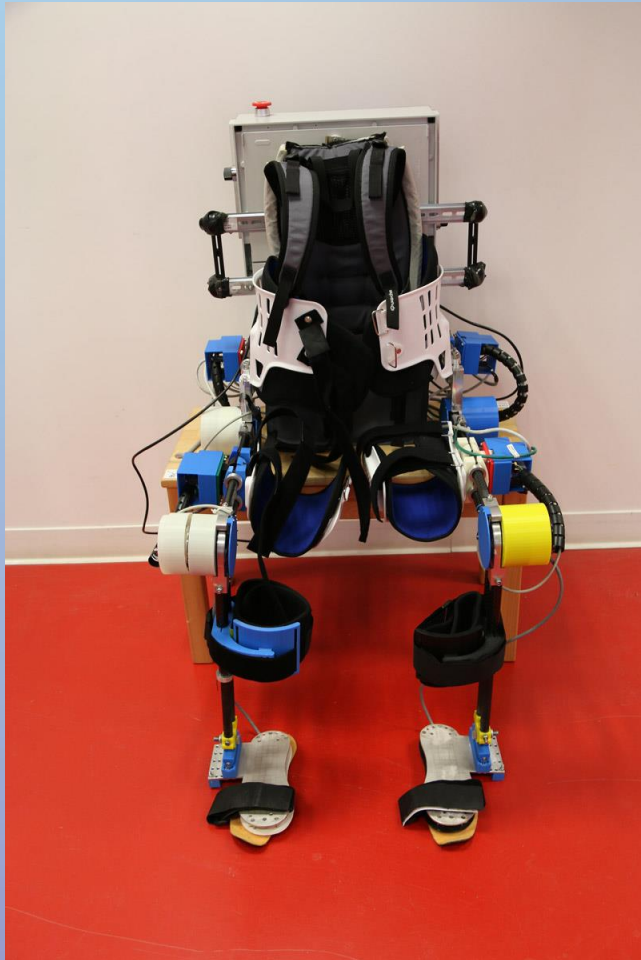
Empowering Children to Walk



Courtesy of NASA

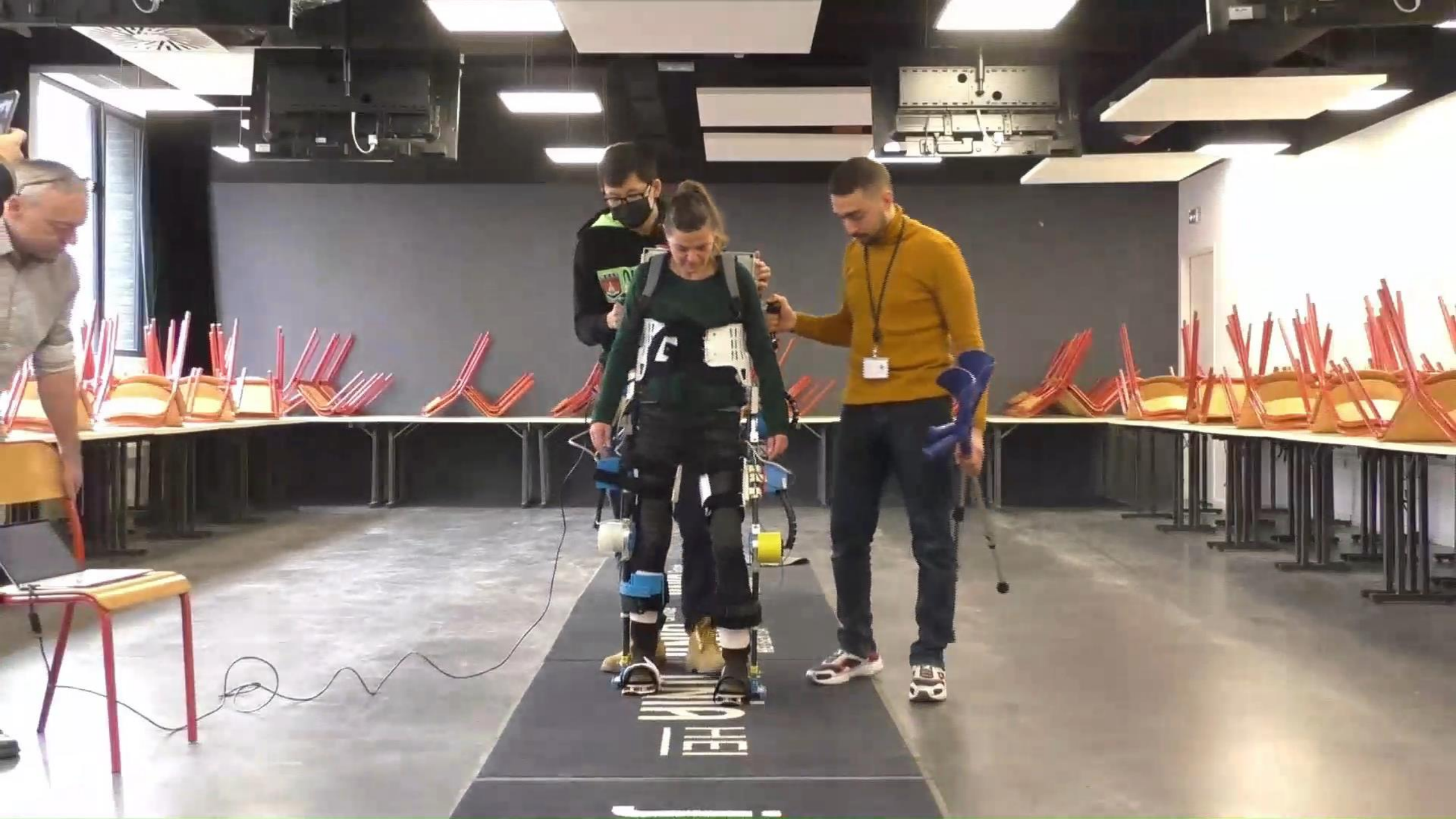


Empowering Children to Walk



Empowering Children to Walk

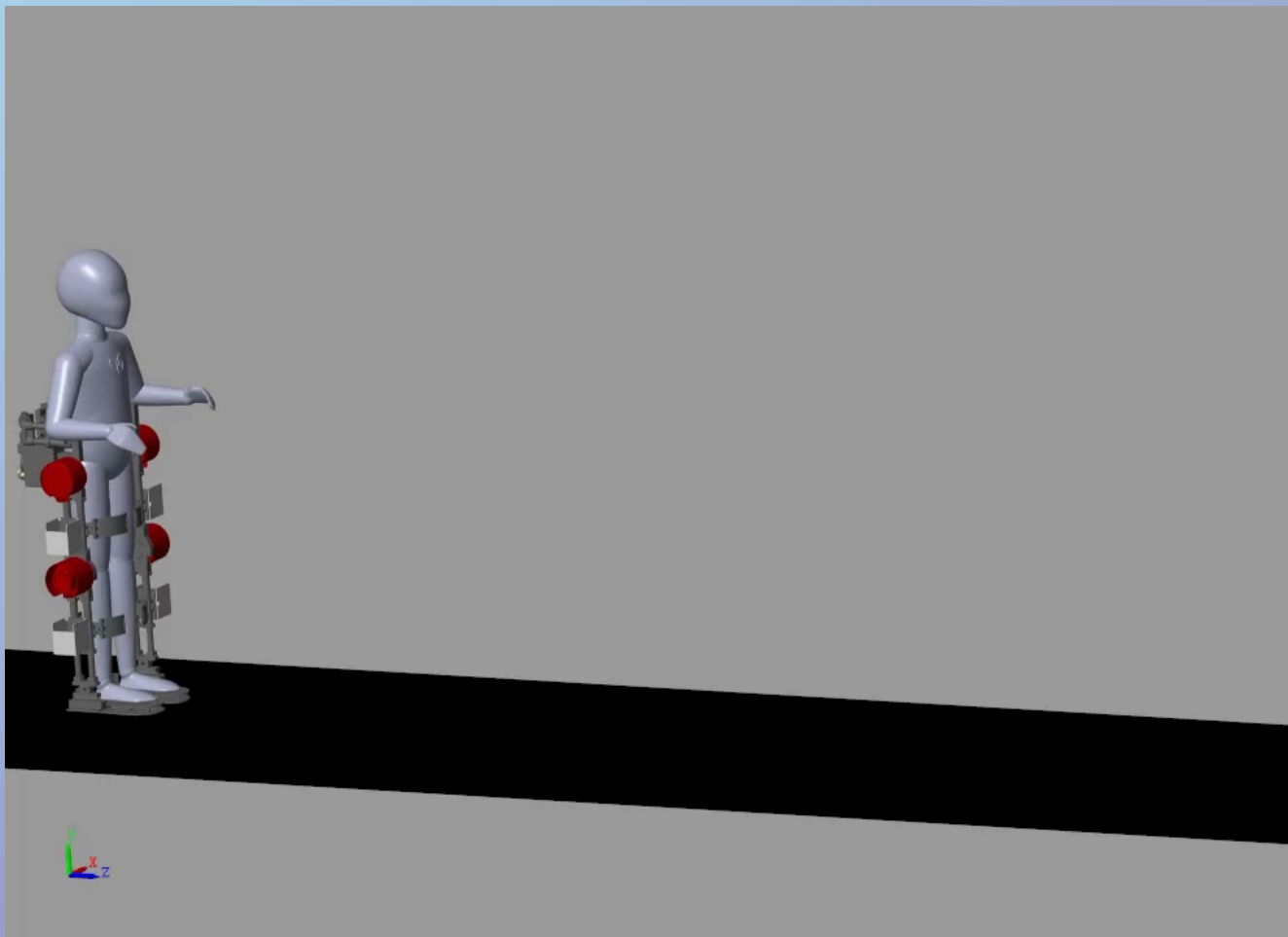




“Designing in C++, you have a lot of code to enter to realize one functionality. Model-Based Design with MATLAB and Simulink was really a **timesaving tool** for us.”

—Yang Zhang, postdoctoral researcher at JUNIA HEI

Empowering Children to Walk



Moonshot: Improving Quality of Life through Healthcare







20
uV/D Dep. Gain: 20 uV/D

Plan 1

Center

0.00

0.00
0.00

20 uV

Play

DD

DT

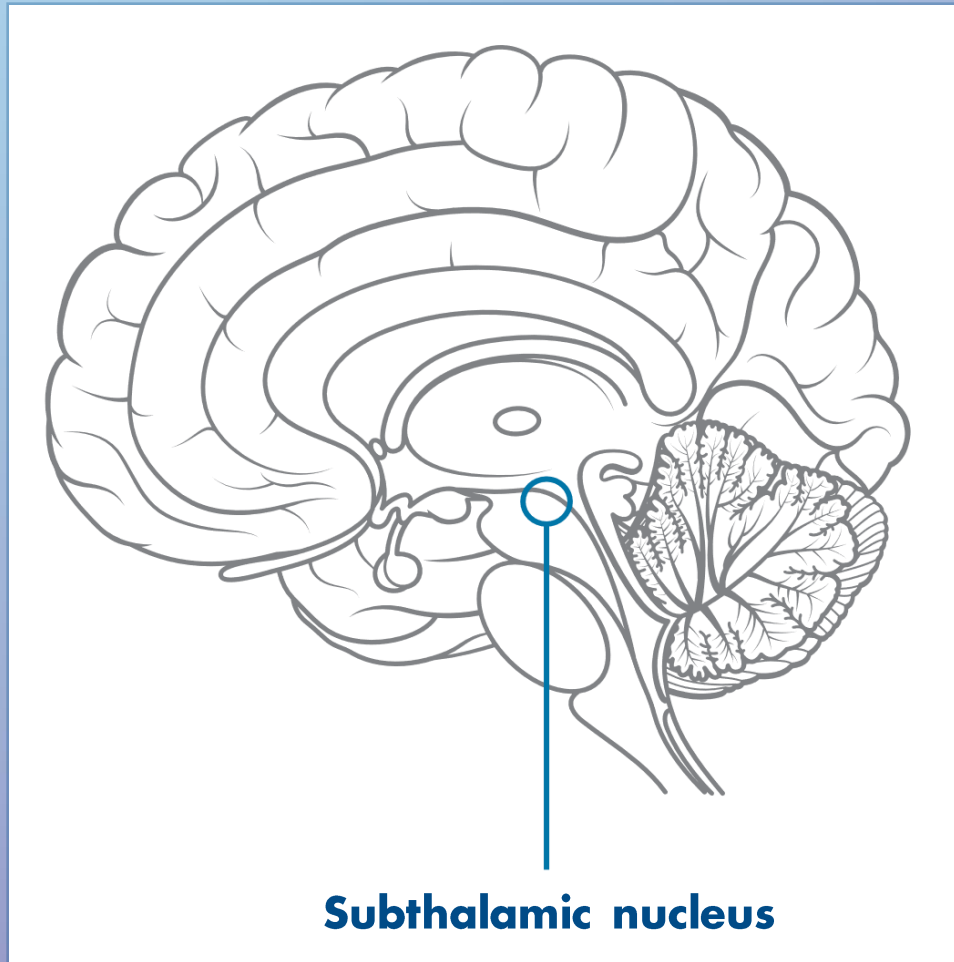
Segment 1

Center

10.0

8.0

Fighting Parkinson's Disease with AI



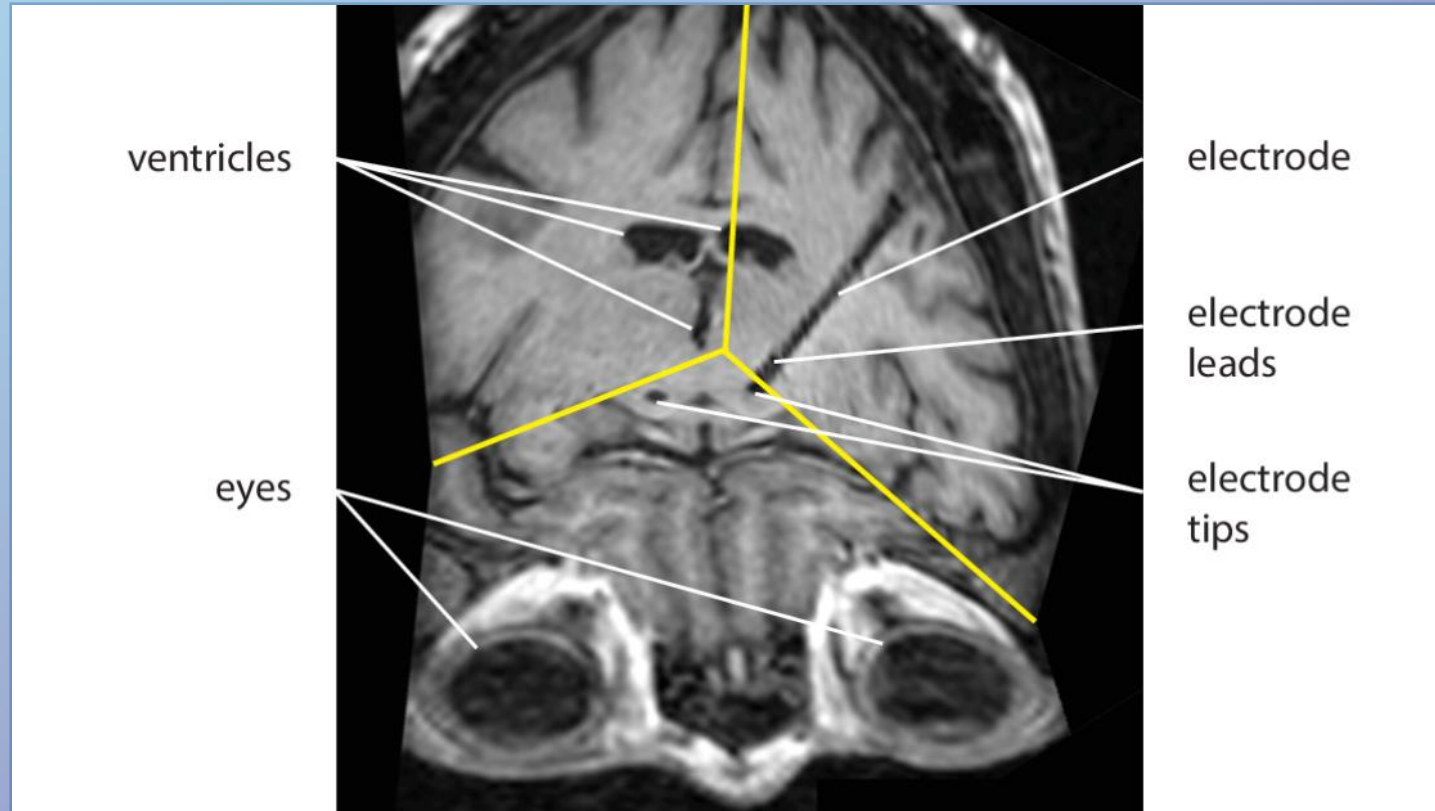
“A **neurological minefield** surrounds the subthalamic nucleus. If you put the electrode in the wrong spot, it can severely alter the patient’s emotions.”

—Dr. Konrad Ciecierski, assistant professor at NASK

Fighting Parkinson's Disease with AI

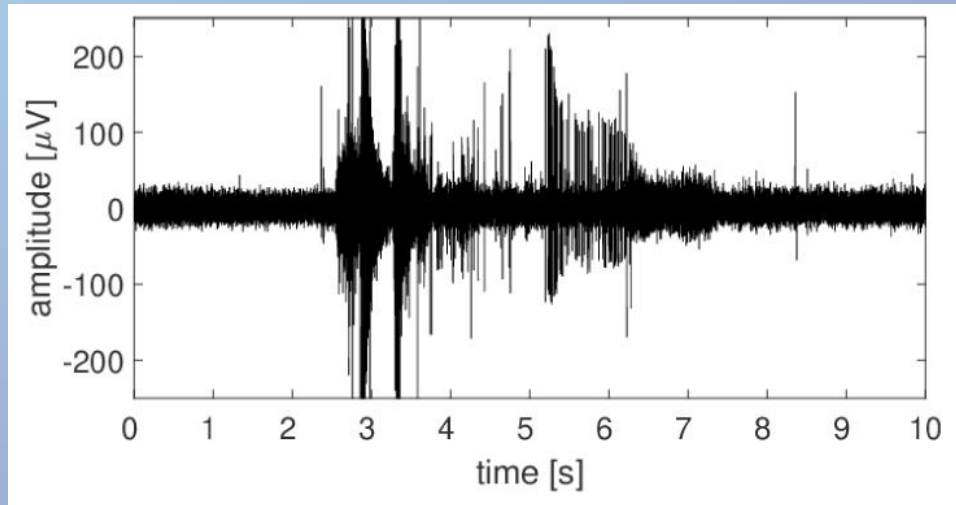


Fighting Parkinson's Disease with AI



Fighting Parkinson's Disease with AI

Original
Signal



Fighting Parkinson's Disease with AI

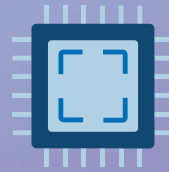
Data Cleansing
and Preparation



AI Modeling
and Tuning

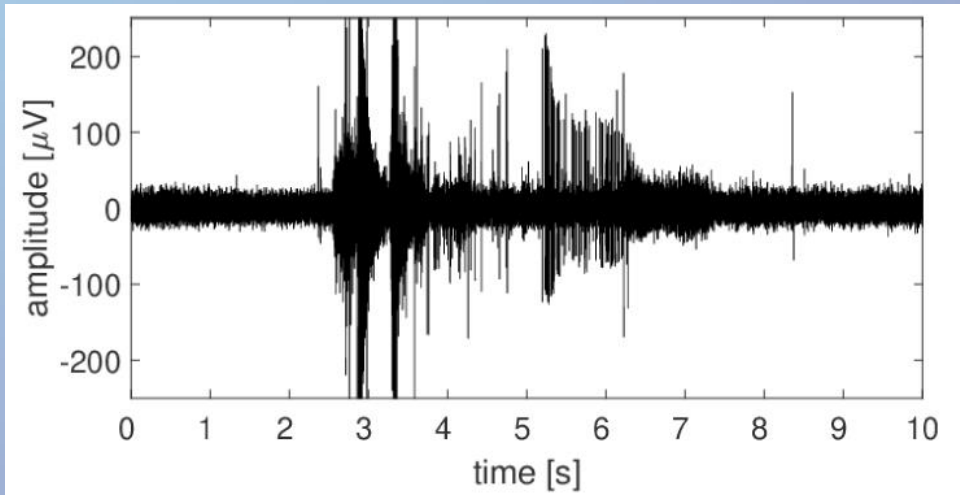


Deployment

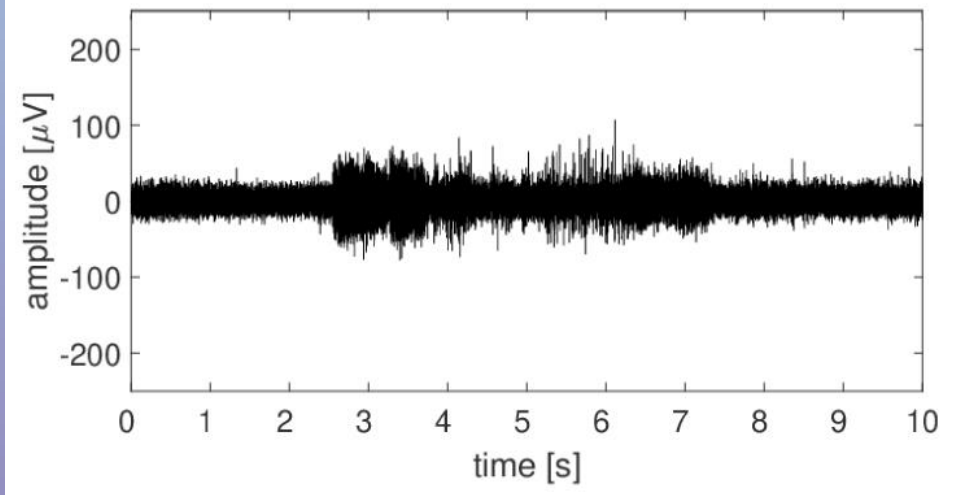


Fighting Parkinson's Disease with AI

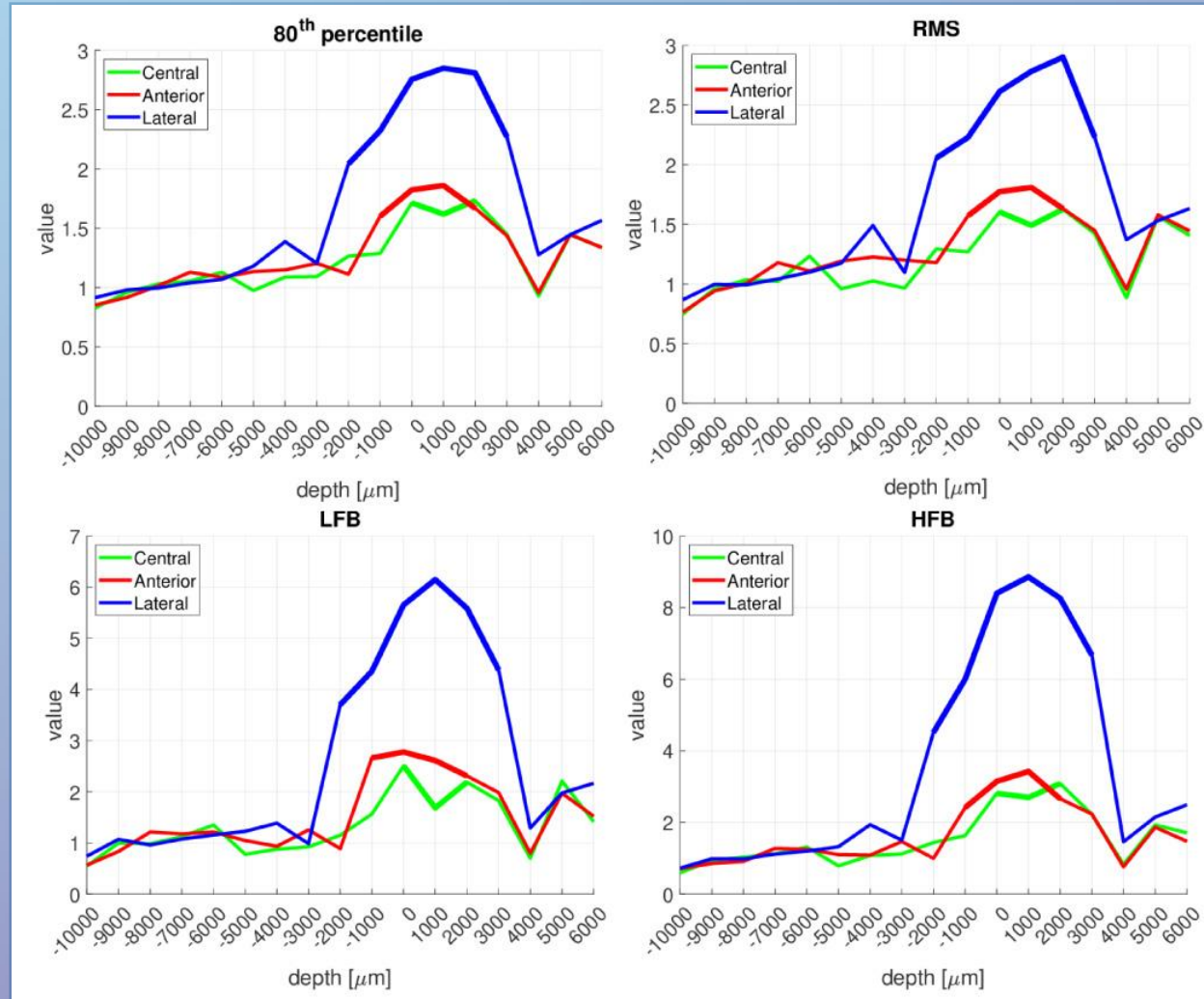
Original
Signal



Filtered
Signal



Entire process takes only 2 minutes
and is 97% accurate





AI & Autonomous Systems

MASTER CLASS

Driving into the Future:
AI-Enabled Autonomous Systems



Jayanth Balaji Avanashilingam, MathWorks



Dr. Rishu Gupta, MathWorks



Peeyush Pankaj, MathWorks

TECHNOLOGY SHOWCASE

Artificial Intelligence: From Design to Deployment

Robotics and Autonomous Systems:
Development to Testing and Deployment



Wireless Connectivity & Radar

MASTER CLASS

FPGA-Based Implementation of
Beamforming Algorithms for Radar and
Wireless Systems



Sumit Garg, MathWorks

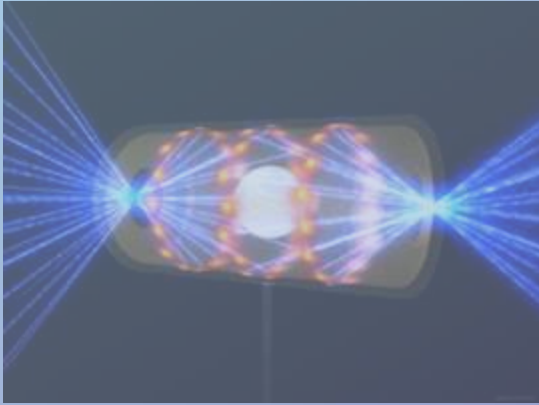


Kishore Siddani, MathWorks

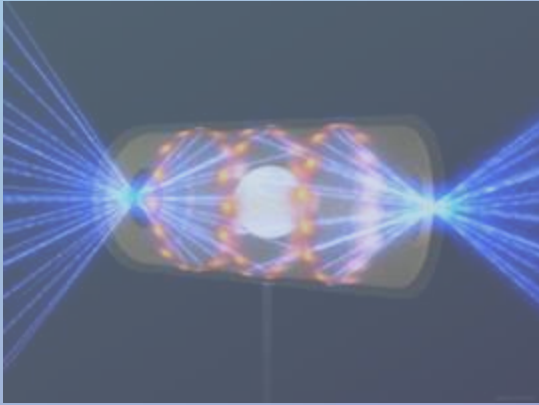
TECHNOLOGY SHOWCASE

Communications and Radar Systems:
From Design to Deployment

Moonshots: Projects with lofty and seemingly impossible goals



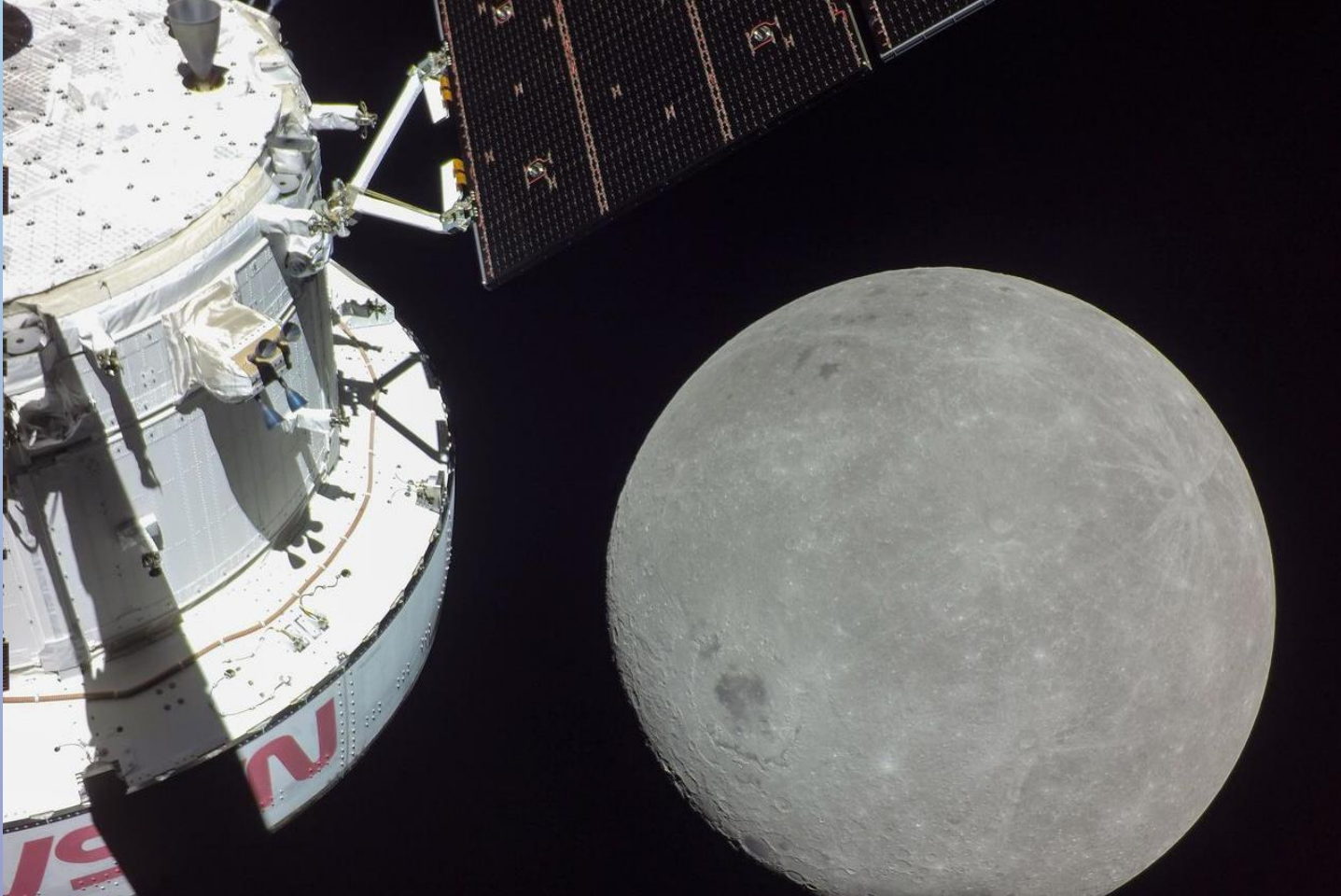
Moonshots: Projects with lofty and seemingly impossible goals



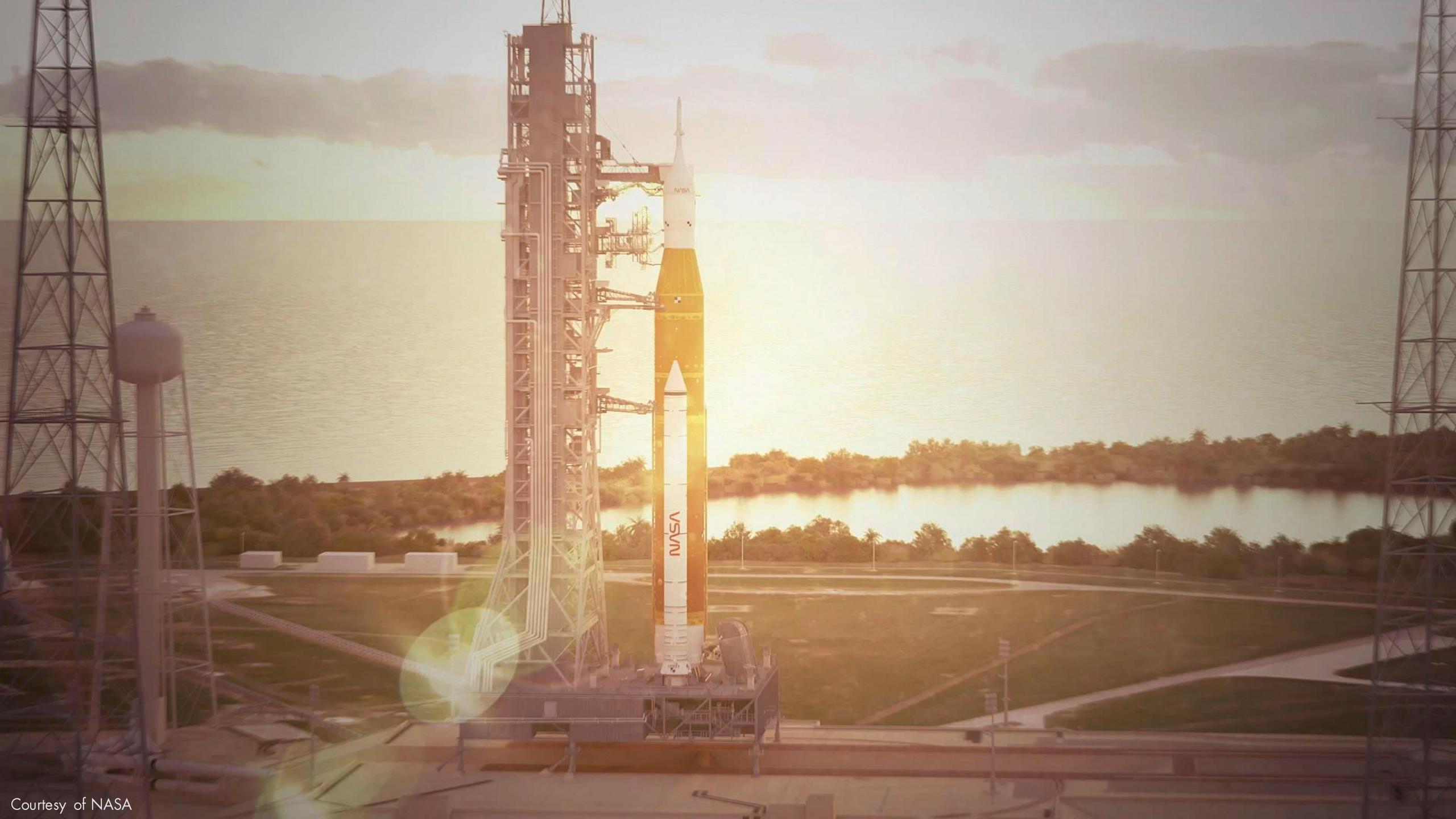
Moonshot: Space Exploration



To the Moon and Beyond



Courtesy of NASA









Orion Power System
Analysis

Simscape Electrical

Mission Management
Algorithm Validation

Stateflow

Orion Guidance, Navigation
and Controls Design

MATLAB

Simulink

Embedded Coder

Launch Tower Modeling

Simscape

Simscape Fluids



Courtesy of NASA

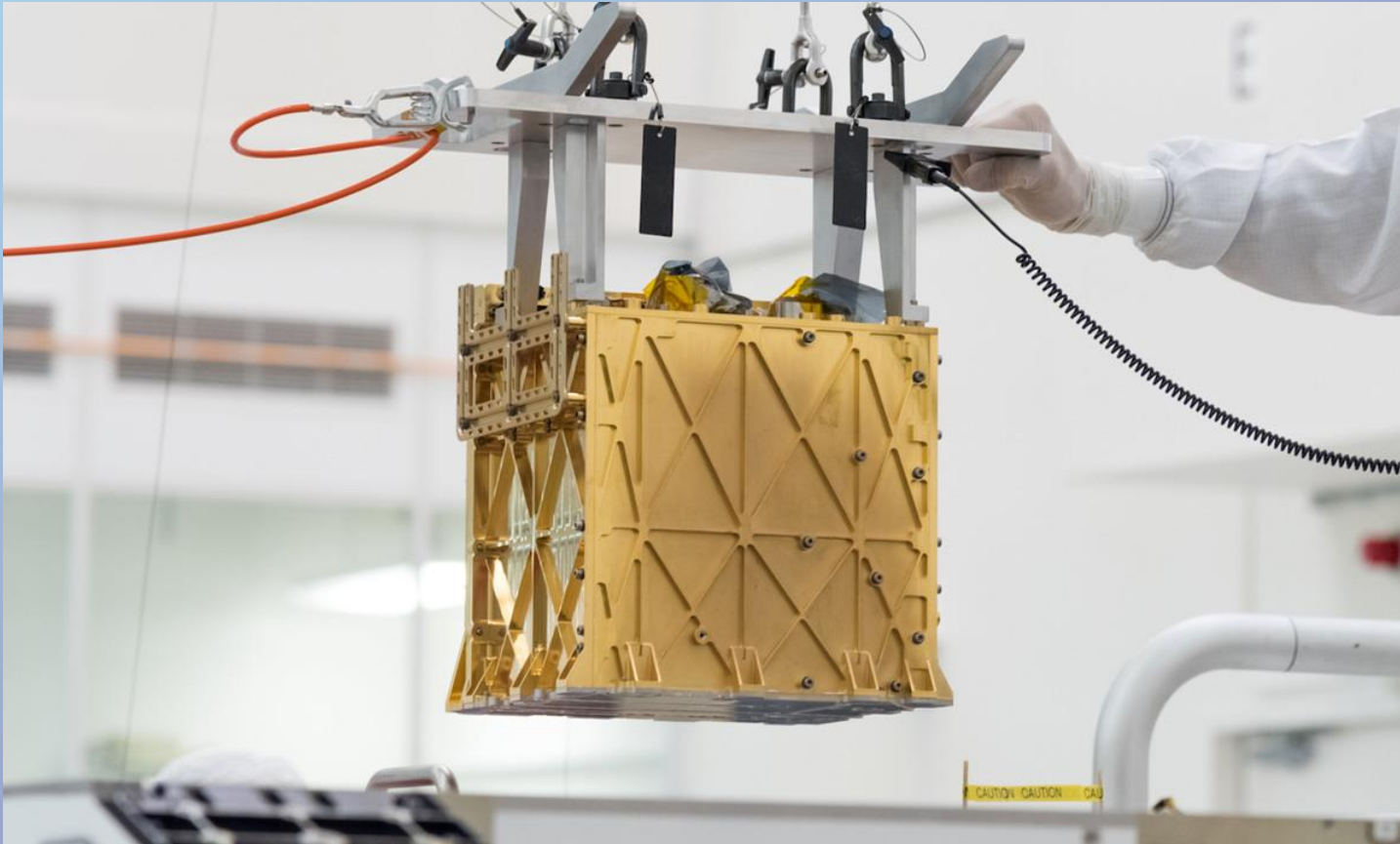


Making Oxygen on Mars

Challenge: 25 metric tons of oxygen required to support a four-person crew, costing billions

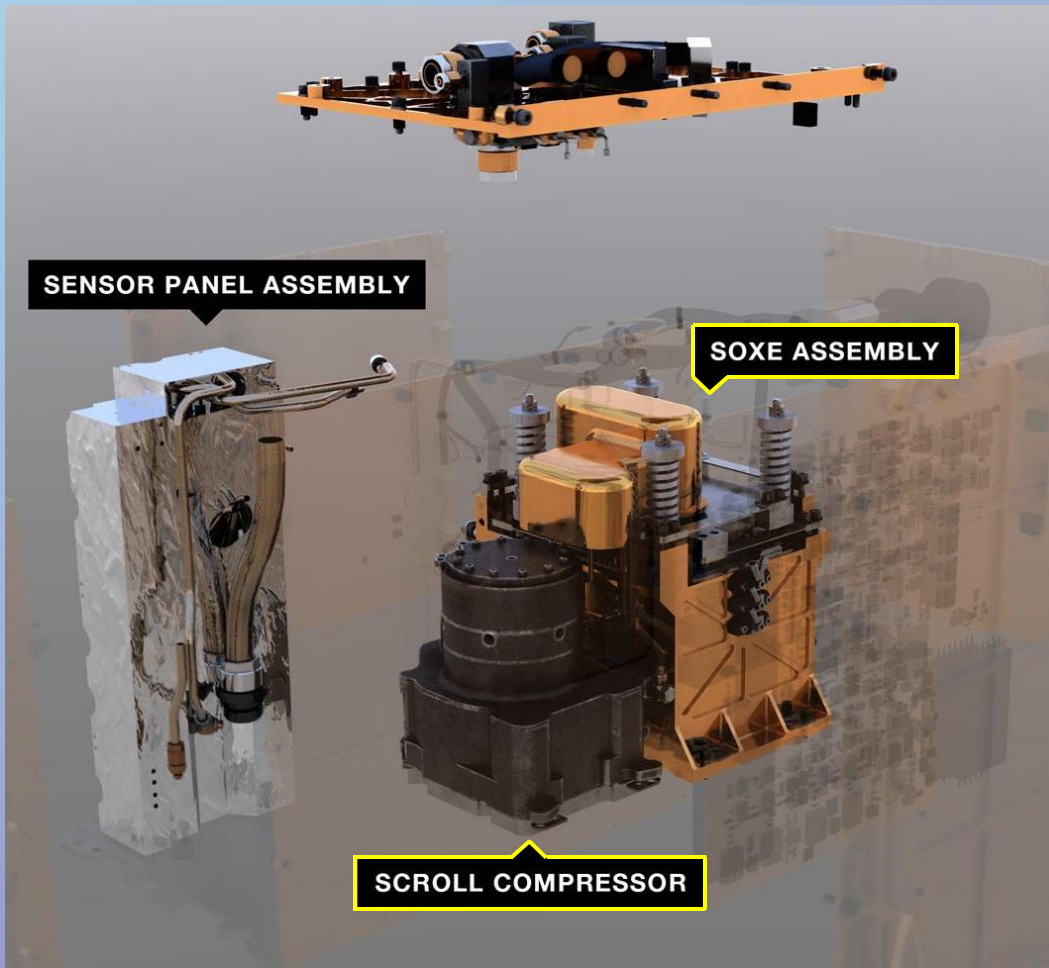
Solution: Extract oxygen from the atmosphere by separating it from carbon dioxide

Making Oxygen on Mars



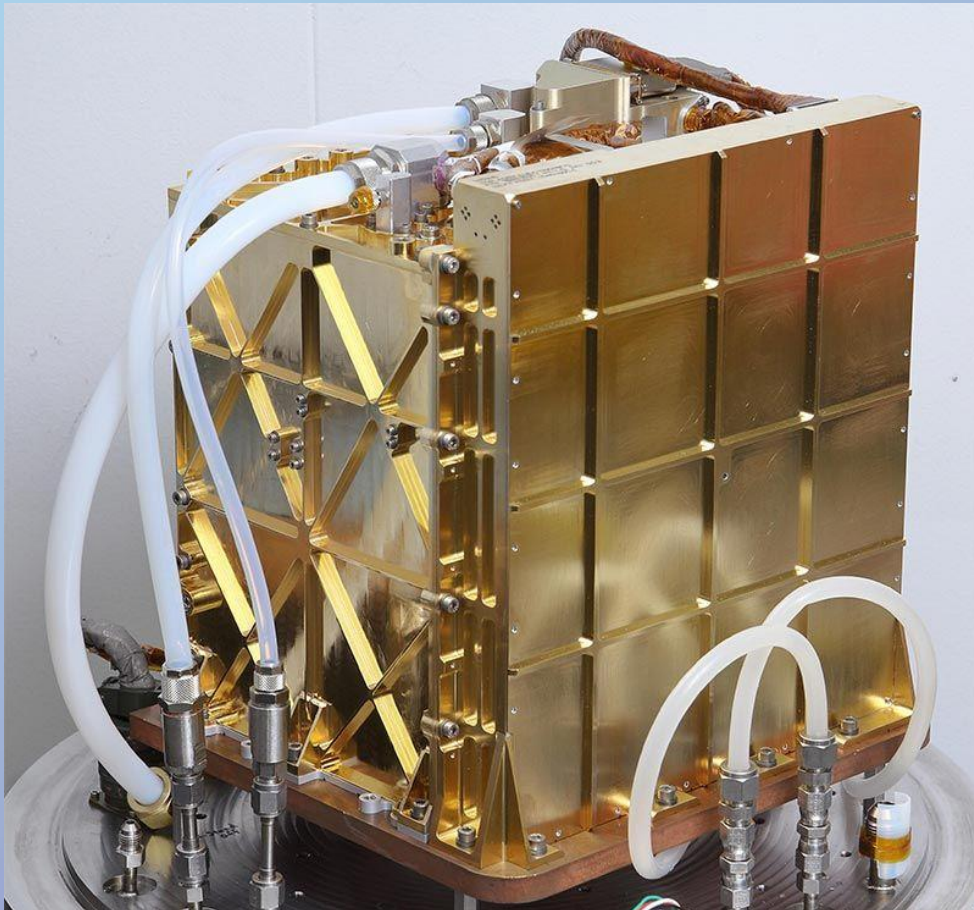
Courtesy of NASA

Making Oxygen on Mars



Courtesy of NASA

Making Oxygen on Mars



MOXIE Simulation Controller

MOXIE Simulation Controller File View Hardware Model I/O RCT Help

MOXIE Simulation Controller | MARS 2020

MOXIE Mars Oxygen ISRU Experiment

MARS 2020

MOXIE Flight Dynamics Systems Model Primary Inputs

Mars Parameters

Input Mars Parameters By:
Location Atmospheric Conditions

Input Location
Use Pre-created MCD Dataset? Yes No [i](#)

Location [i](#)

Latitude ° [i](#)

Longitude ° [i](#)

Sol of Year [i](#)

Time of Sol [i](#)

Weather Event [i](#)

[Visualize Location on Mars Map](#) [i](#)

Extracted Mars Parameters

Ambient CO Fraction	<input type="text"/>	Ambient O2 Fraction	<input type="text"/>
Temperature (C)	<input type="text"/>	Pressure (mbar)	<input type="text"/>

MOXIE Parameters

Compressor RPM Offset

SOXE Parameters

Temperature (°C) Operating Current (A)

Run Simulation

Simulation Time (s) [i](#)

Off On Optimize Performance

Outputs 3/6 | Outputs 4/6 | Outputs 5/6 | Outputs 6/6 | Summary: Maxes/Averages

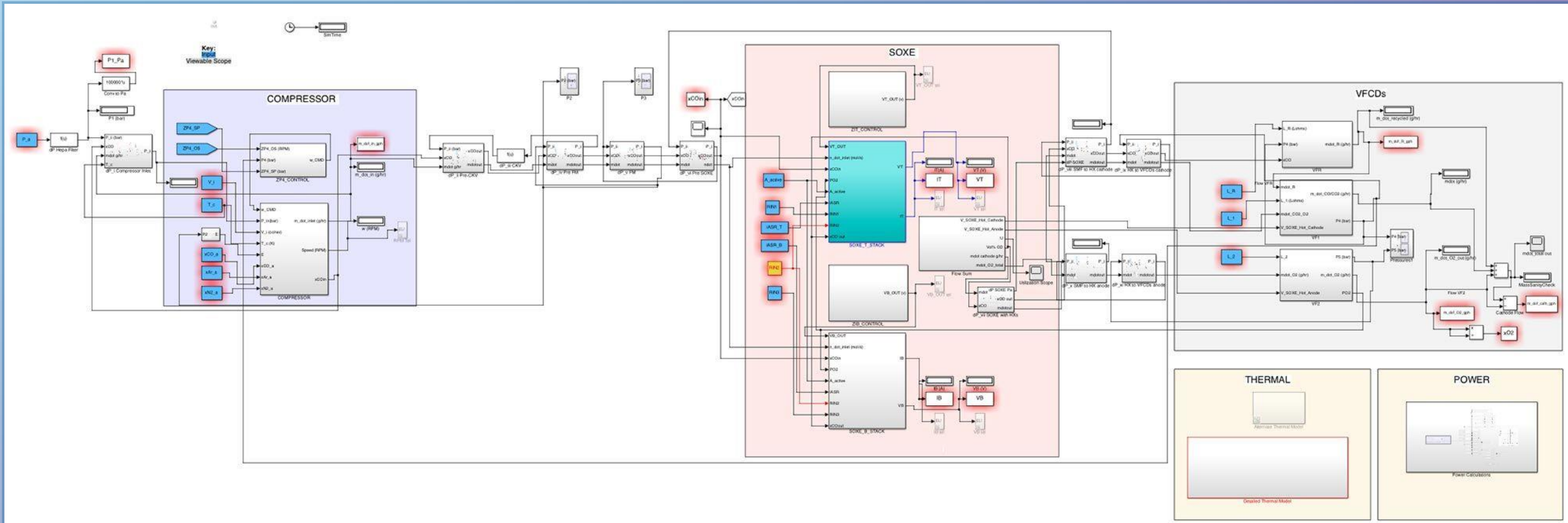
Cell Temperature (Across Cells 1-10)

Temperature (°) vs Time (s)

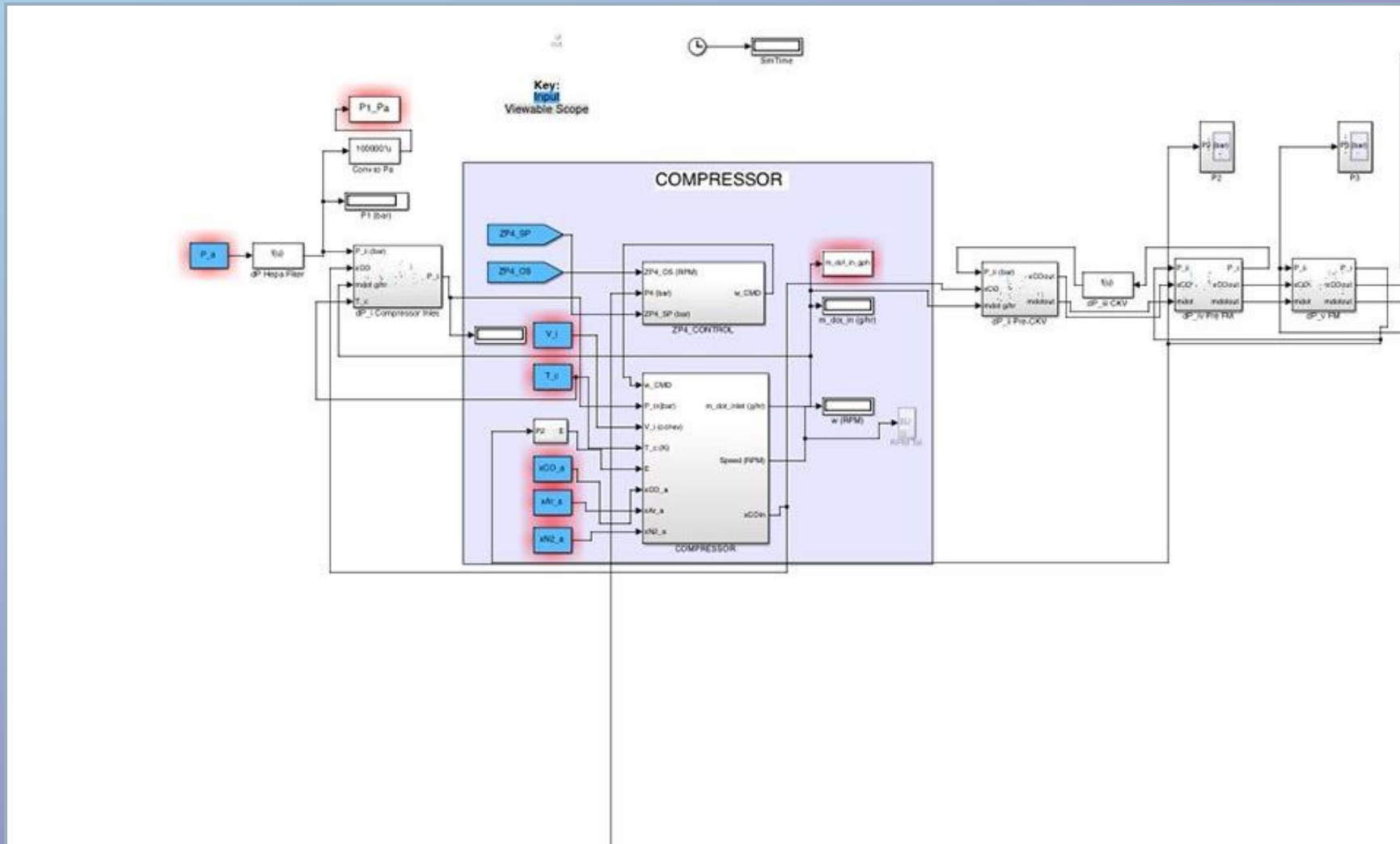
Oxygen Production Rate

Production (g/hr) vs Time (s)

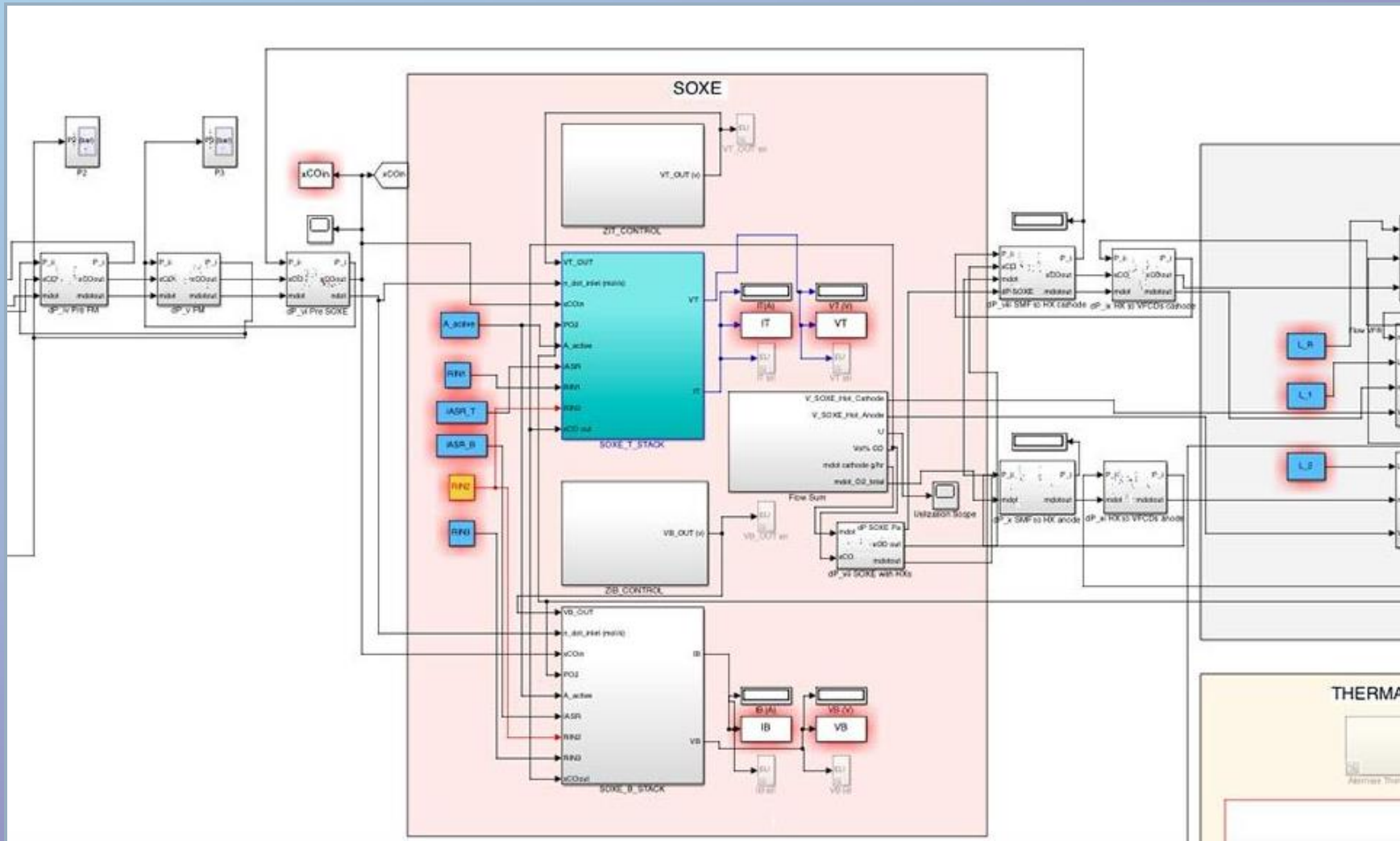
Simulink Model for MOXIE



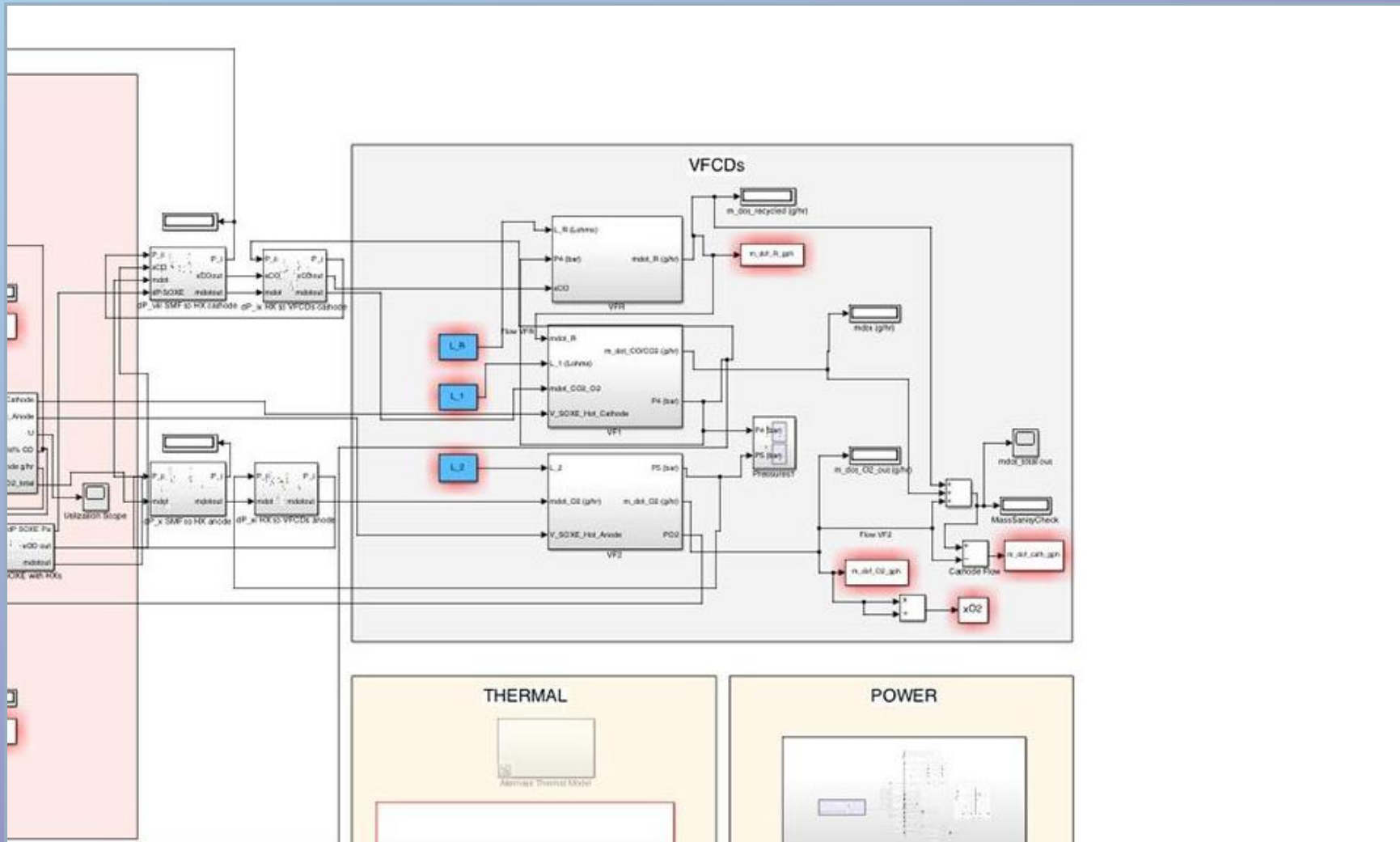
Simulink Model for MOXIE



Simulink Model for MOXIE



Simulink Model for MOXIE





Modeling, Simulation, and Implementation

MASTER CLASS

Developing Safe and Secure Embedded
Software from Desktop to Cloud Using
Model-Based Design



Rajat Arora, MathWorks



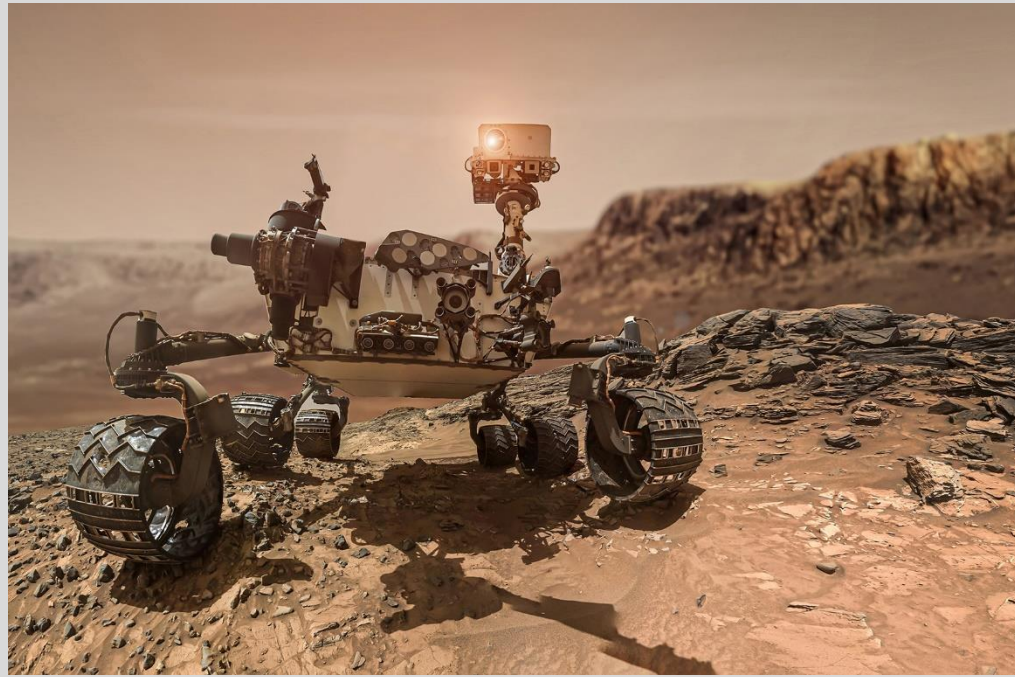
Gaurav Ahuja, MathWorks

TECHNOLOGY SHOWCASE

Model-Based Systems and Software
Engineering

Perseverance rover just made oxygen on Mars

– **CNN**



Making Oxygen on Mars

Simulink for modeling three control loops: internal pressure, temperature, and voltage

MATLAB for optimizing hardware layout, minimizing mass, and simulating conditions



Chandrayaan-3: India's Moonshot



Announcing the launch of Chandrayaan-3:

LVM3-M4/Chandrayaan-3 Mission:

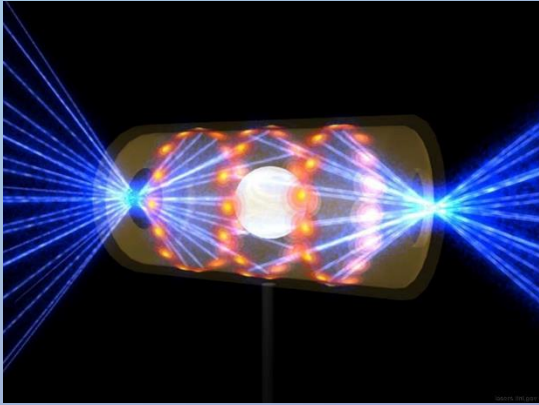
The launch is now scheduled for **July 14, 2023, at 2:35 pm IST** from SDSC, Sriharikota

Stay tuned for the updates!

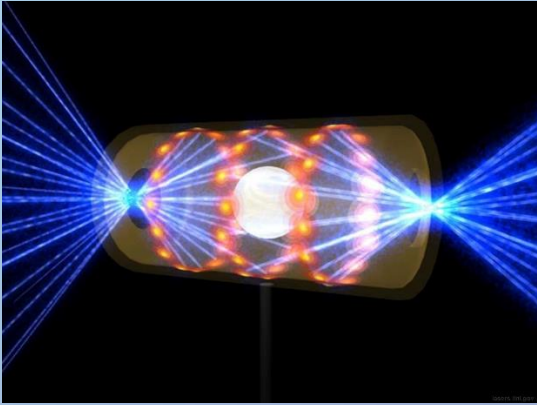
5:06 PM · Jul 6, 2023 · **1.7M** Views

7,304 Retweets **764** Quotes **34.7K** Likes **267** Bookmarks

Moonshots: Projects with lofty and seemingly impossible goals



Moonshots: Projects with lofty and seemingly impossible goals



MATLAB EXPO



AI



Algorithm Development
and Data Analysis



Autonomous Systems and
Robotics



Cloud, Enterprise, and
DevOps



Electrification



Modeling, Simulation,
and Implementation



Preparing Future Engineers
and Scientists



Wireless Connectivity
and Radar

MATLAB EXPO

Thank you



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