What is AI?

AI (Artificial Intelligence): The broad field of creating machines or software that can perform tasks usually requiring human intelligence, such as learning, reasoning, and problem-solving.

Everyday AI

Voice-Controlled Assistant
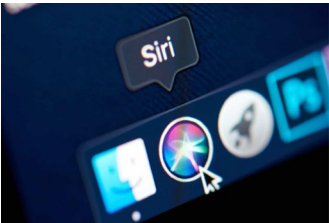
Facial Recognition

Intelligent Navigation

Generative AI

ChatGPT

Bard   Gemini   Microsoft 365 Copilot
2023 - 2024   2024 - now

CDO Chief Data Officer   CAIO Chief Artificial Intelligence Officer

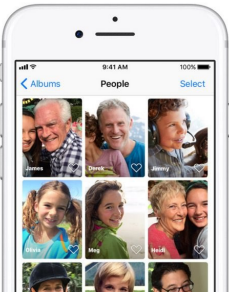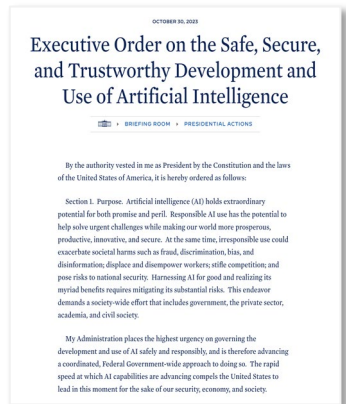# Types of AI and Differences

- **AI (Artificial Intelligence):** The broad field of creating machines or software that can perform tasks usually requiring human intelligence, such as learning, reasoning, and problem-solving.

- **ML (Machine Learning):** A subset of AI focused on building systems that can learn from data and improve their performance over time without being explicitly programmed.

- **LLM (Large Language Model):** An LLM is an advanced AI system trained on vast amounts of text data to understand and generate human-like text.

- **NLP (Natural Language Processing):** A field of AI that focuses on the interaction between people and computers enabling machines to understand, interpret, and generate human language.

- **ChatGPT:** An AI chatbot based on the GPT model that can engage in conversations, answer questions, and generate text based on prompts.

- **GenAI (Generative AI):** AI that creates new content, such as text, images, music, or videos, based on the data it has been trained on.

- **GPT (Generative Pre-trained Transformer):** GPT is a type of LLM specifically designed to generate coherent and contextually relevant text based on pre-training on large datasets

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The Federal Government is focused on AI

White House: "Executive Order 14110"

"Artificial intelligence (AI) holds extraordinary potential for both promise and peril. Responsible AI use can help solve urgent challenges and enhance prosperity, productivity, and security. […] Harnessing AI for good requires mitigating its substantial risks […] through a society-wide effort involving government, the private sector, academia, and civil society."

https://www.whitehouse.gov/briefing-room/presidential-actions/2023/10/30/executive-order-on-the-safe-secure-and-trustworthy-development-and-use-of-artificial-intelligence/

OMB M-24-10 Compliance Plan

In response to the White House Executive Order 14110 and OMB M-24-10, all federal agencies must publish their compliance plan stating how they will seize the opportunities AI presents while managing its risks.
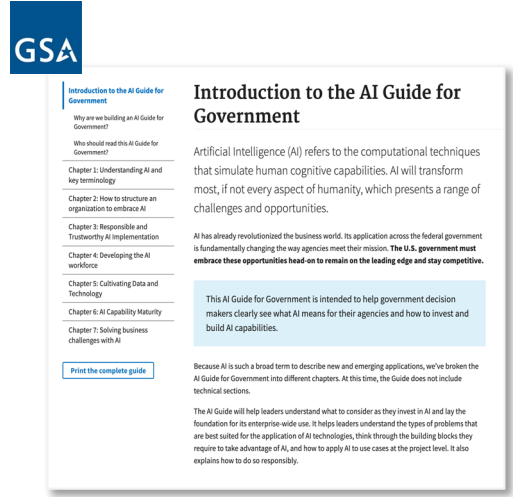
Plan submitted to OMB 24 September 2024.

nasa-omb-compliance-plan-20240923.pdf
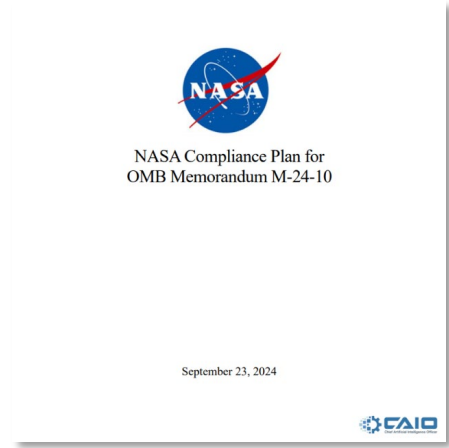
GSA: "The AI Guide for Government"

"A living and evolving guide to the application of Artificial Intelligence for the U.S. federal government, provided by the GSA IT Modernization Center of Excellence."
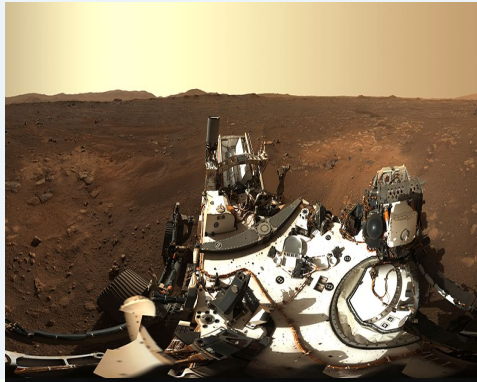
https://coe.gsa.gov/coe/ai-guide-for-government/introduction/index.html

Mission Value from AI @ NASA

Enable the Impossible

Mission-Embedded AI:

Rovers, Satellites, Spacecraft, Aircraft, UAS, Habitats, Coordination & Control…

- AI Image Analysis for Space Inspection (e.g., Glove)
- Enable Scaled Air Traffic Control
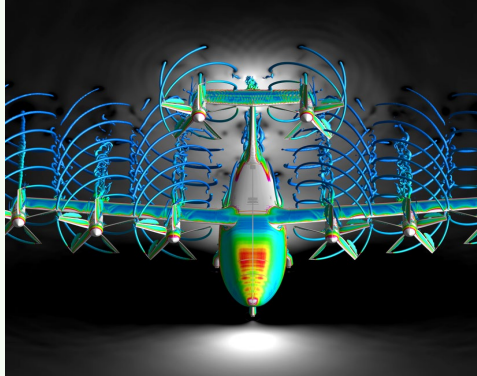- Detect and Recover from Emergencies
- Early Warning of Severe Storms
- Discover ExoPlanets and Multi-Star Systems

Fuel Technical Work

Mission-Enabling AI:

Research, Engineering, Science; Labs, Experiments, Tests, Requirements, Plans, Analysis…

- AI-Assisted Vehicle Design / Engineering
- AI-Enabled Project Management
- AI-Augmented PSR Images for Lunar Plans
- AI-Augmented System Engineering
- Predictive Modeling – AI-Enhanced Digital Twin

Bolster Effectiveness

AI in Mission Support:

Finance, Procurement, Information Technology, Security, Facilities, Human Resources…

- Automate Repetitive Processes
- Condition Based Facilities Maintenance
- AI-Fueled IT Security
- HR – Resume Reviews; Performance
- AI-Enabled Financial Analysis & Fraud Det.

NASA AI Objective Function: Maximize Mission Benefit from AI while Managing AI Risks

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What is Different About AI Today?

THEN: AI for Gurus

AI experts at NASA

created **custom** AI tools

to perform **critical work** at NASA

with **individual investments**

Generative AI

NOW / SOON: AI for All

Every worker at NASA

uses **powerful, plentiful, secure** AI tools

to augment all work across NASA Missions and Support

with largely **shared investments**

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GenAI Opportunities at NASA

Text: Written paragraphs, summaries, outlines, blog posts, poetry, songs, more

- Engineering Digital Assistant

- Literature Reviews

- Digital Assistant for State-of-the-Art Instrumentation

- NASA Document Writing Co-Pilot

- NASA Materials Advisor

- NASA Process Navigator

- NASA Project Co-Pilot

- Procurement Requirements

Advisor

Code: Create, document, explain, debug; translate between coding languages

- Application modernization

- Augmented Reality/Virtual Reality (AR/VR)

Images: Rapidly create art, including photo-realistic
Mission concepts
Citizen inspiration

Prompt: *"Create a realistic image of astronauts exploring mars with habitats and scientific instruments based on NASA's Artemis mission concept"*

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Summer of AI Overview

Campaign

- Designed to leverage existing agency platforms, programs, and services

- **Has not cost the agency anything outside of workforce hours**.

- Using employee learning history, we recorded **881 AI Percipio learners** at NASA before SoAI.

- In the first six weeks of our launch, we've reached **more than 1,600 AI learners with 11 Summer of AI events.**

Design

- Self-paced, live learning, speaker series with experts, and virtual chat sessions with senior leaders. Campaign was based on Gartner's analysis on differing learner needs. Their research shows that:
  - **women** are less comfortable taking risks and failing when learning
  - **younger generations** want more control and ownership to direct their learning, but also need more support to enable it
  - **neurodivergent employees** may find unfamiliar environments or verbal conversations more challenging

OCHCO Staffing Initiative - Partnership for Public Service

- NASA will participate in the **Cybersecurity and Artificial Intelligence Talent** Initiative
  - Enables hiring of **pre-vetted, diverse** applicants from **colleges and universities around the US**
  - Participation includes a **1-year onboarding program for 20 early career employees**

NASA Approach to AI Moving Forward

Guiding Principles:

- Maximize benefit, manage risk
- Build upon existing mission AI momentum
- Empower workers with AI
- Governance: coordination vs. control
- Share best practices, pool investments
- Learn & evolve

Progress:

- ✓ Establish Chief AI Officer
- ✓ Establish federated AI governance
- ✓ Summer of AI Learning Campaign
- ✓ Published NASA AI Compliance Plan

Next Steps:

- Complete OMB required actions
- Publish NASA specific Strategy, Policy, and other guidance
- Agency-Wide AI-Readiness Workshops
- Mature AI Governance at the Deputy Administrator level
- Integrate the NASA AI Registry and complete AI Inventory
- AI Tool Onboardings - Fall & Beyond

The Chief AI Officer will orchestrate and facilitate NASA's AI learning journey and adoption of emerging AI capabilities to optimize mission and mission support outcomes
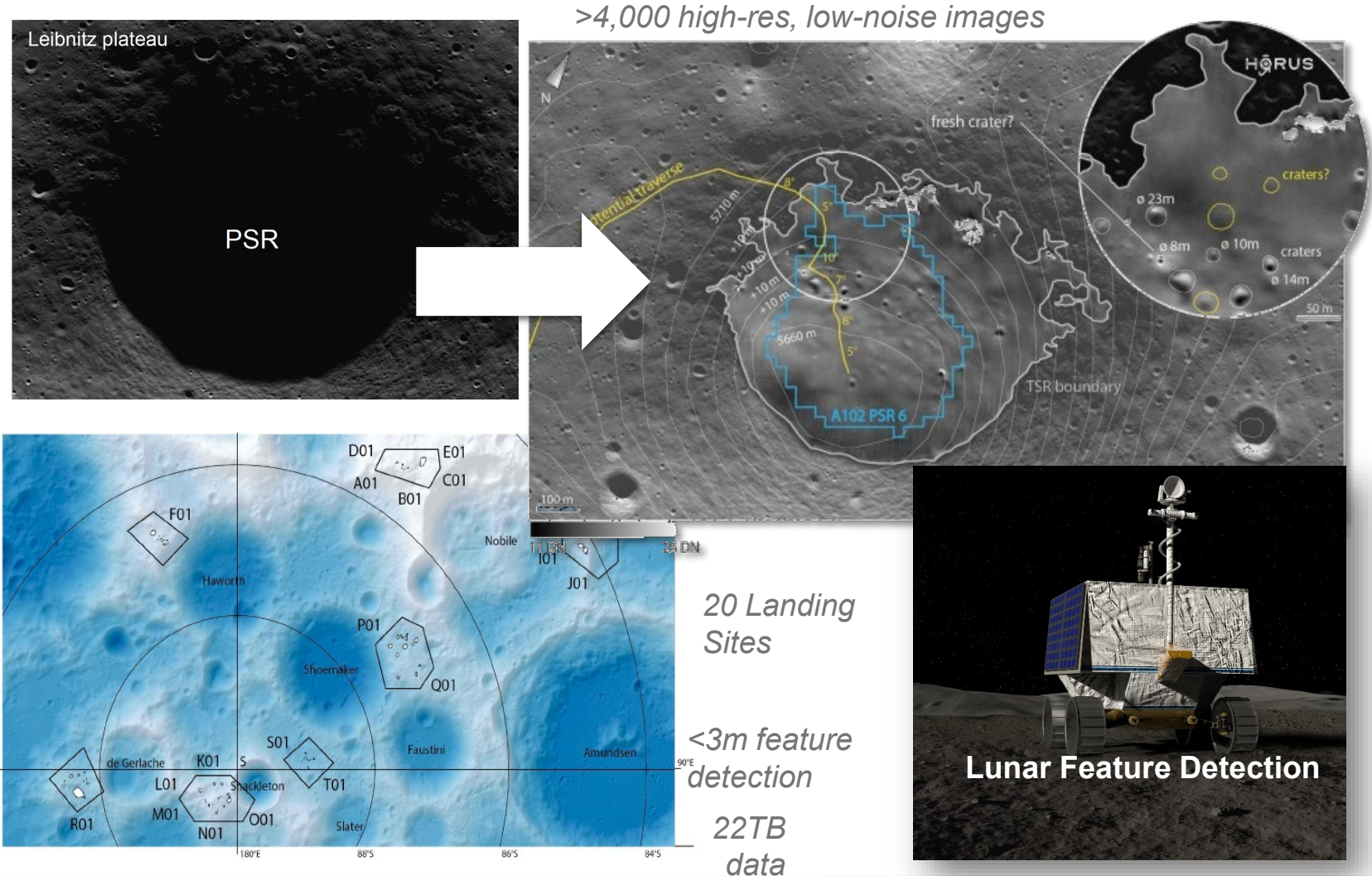

NASA public AI Town Hall, 22 May 2024
https://www.youtube.com/watch?v=n3LH7Hd0L5s

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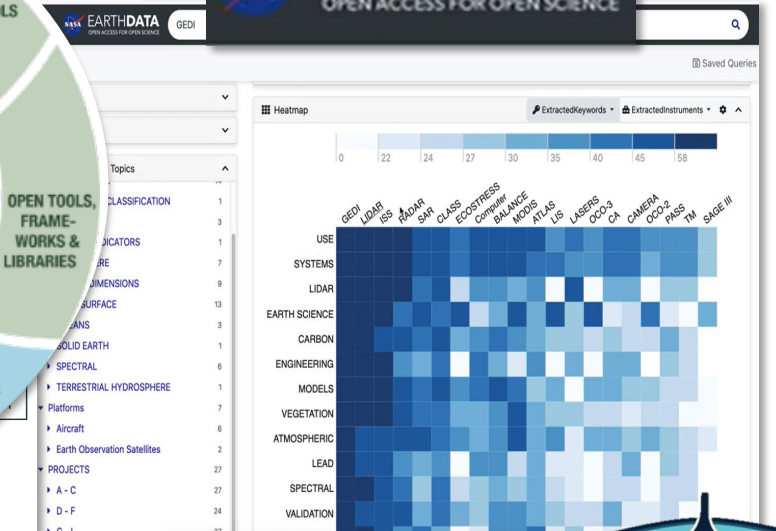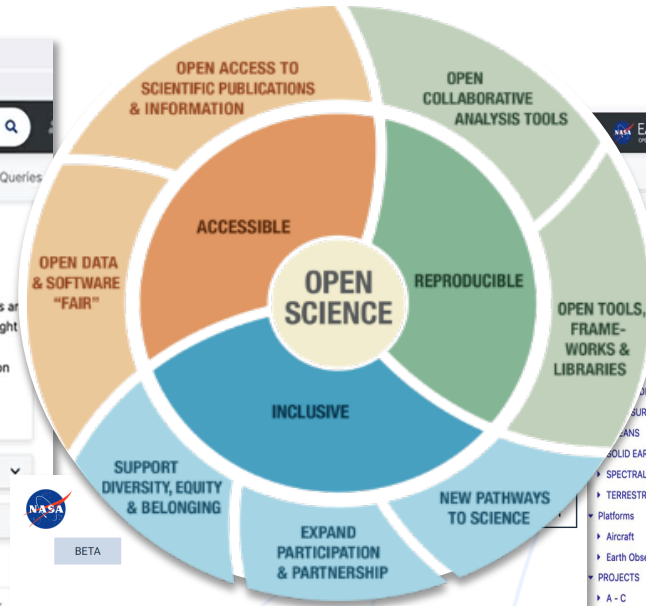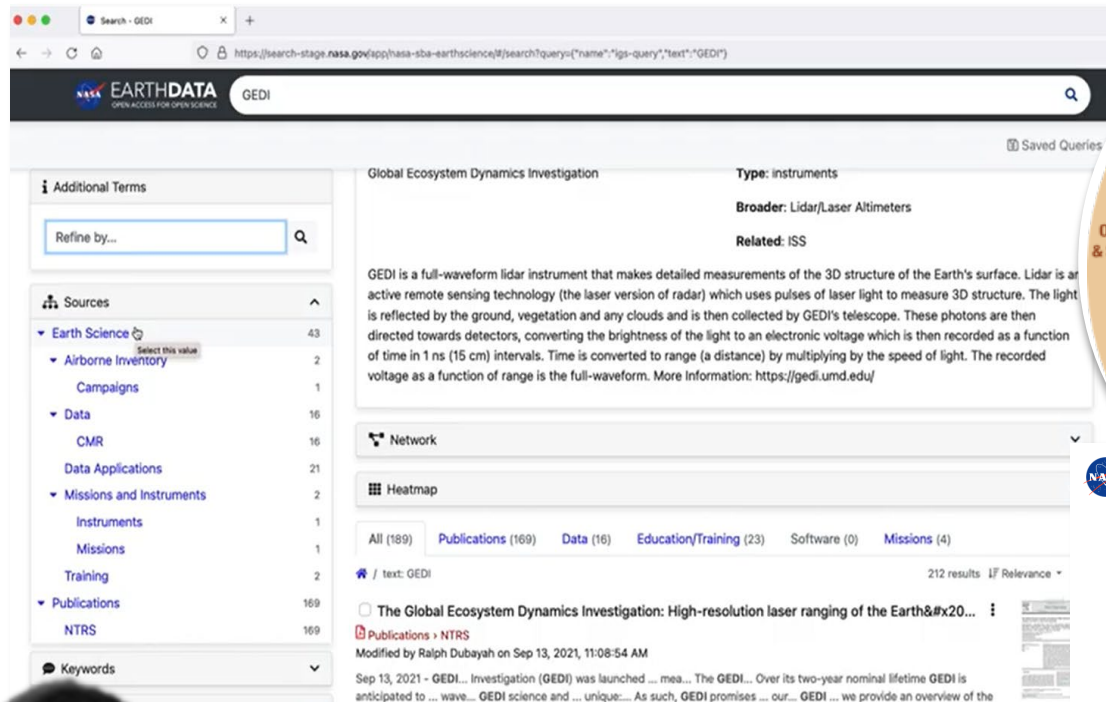# Mission-Embedded AI: Lunar Feature Detection

Leveraged ML for image processing of lunar dark-side data:

Produced >4,000 validated, high-resolution, low-noise images (22TB) with ~3 m feature resolution to **significantly reduce uncertainty** for landing site / traverse planning & science target selection for VIPER & other future missions

Ignacio Lopez-Francos
Ames Research Center

Leibnitz plateau

PSR

>4,000 high-res, low-noise images

20 Landing Sites

<3m feature detection

22TB data

Lunar Feature Detection

Mission-Enabling AI: Science Discovery Engine
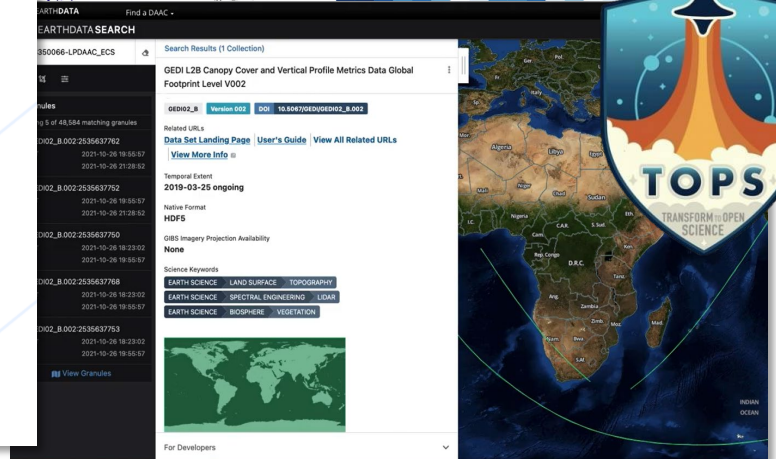
"In the **brief time** that I have explored the new search interface, I was **able to learn a lot** about the GEDI mission, the data that are available, and the calibration & validation that have occurred."

Kaylin Bugbee
Marshall Space Flight Center

Mission-Embedded AI: EVA Glove Inspection

December 2021:
First US AI/ML model on the International Space Station

AI/ML prototype performed diagnostics & generated a GO/NO-GO recommendation on the glove condition in **45 seconds**, a process that normally takes multiple days for a group of people.

Martin Garcia
Johnson Space Center

EVA Glove Inspection

AI in Mission Support: Predictive Maintenance

Analyzing *real-time data & insights* into facilities/systems to **predict probable failures**

Smart Centers today…

… enable **Smart Bases** tomorrow

sUAS INSPECTIONS
DRONES PROVIDE GREATER ACCESS AND NEW PERSPECTIVES FOR ASSESSING INFASTRUCTURE, FACILITIES AND ASSETS

DIGITAL TWINS
DIGITAL RECONSTRUCTIONS AND DYNAMIC MODELS PROVIDE NEW ACCESS AND INSIGHTS TO DESIGN AND MANAGEMENT OF ASSETS

AUTONOMOUS OPERATIONS
AUTOMATING ROUTINE TASKS AND SUPPORTING MORE COMPLEX ONES

PREDICTIVE MAINTENANCE
CBM AND AI/ML TO AVOID FAILURES AND OPTIMIZE O&M

EXTENDED REALITY
AR/VR REMOTE PRESENCE FOR COLLABORATION AND SUPPORT

SPACE OPTIMIZATION
IOT SENSORS DRIVE OPTIMAL SPACE UTILIZATION AND WORKPLACE OF THE FUTURE

Jeff Brandt
Langley Research Center

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More stories of AI and NASA from NASA.gov

- NASA-enabled AI Predictions May Give Time to Prepare for Solar Storms

- AI Is Helping Scientists Discover Fresh Craters on Mars

- AI-Spy with My Little Eye

- NASA Turns to AI to Design Mission Hardware

- NASA AI Technology Could Speed up Fault Diagnosis Process in Spacecraft

- Langley Interns Create Board Game to Ponder the Ethics of AI

- NASA Goddard Collaborates with Intel Corporation to Offer AI Learning

- AI for Earth: How NASA's Artificial Intelligence and Open Science Efforts Combat Climate Change

- NASA AI Technology Could Speed up Fault Diagnosis Process in Spacecraft

- NASA Researcher's AI 'Eye' Could Help Robotic Data-Gathering

- NASA Scientist Looks to AI, Lensing to Find Masses of Free-Floating Planets

- SPoRT's Lightning Prediction Tool Provides Critical Weather Forecasting Support at Rock the South

- New AI Algorithms Streamline Data Processing for Space-based Instruments

- NASA and UC Berkeley Host Discussion on the Future of AI at Work

- John Moisan Studies the Ocean Through the 'Eyes' of AI

- Discovery Alert! Two new planets – found by AI

- SuperCam Gains New Artificial Intelligence Capabilities with AEGIS Upgrade

Questions? Comments?