



Hurricane Hugo devastated three fourths of homes in the historic district of Charleston, SC. AI applications support disaster response and recovery for natural disasters such as the one Charleston sustained. AI technology offers an unprecedented capability to anticipate, mitigate, and respond to hard-to-predict disasters in ways that no other technology can.



Universities
Space Research
Association

ARTIFICIAL INTELLIGENCE

USRA's Research Institute for Advanced Computer Science: Pioneering Breakthroughs Since 1963

USRA has pioneered several industry-first innovations in artificial intelligence and machine learning:

- First Artificial Intelligence (AI) plan for NASA Ames in 1984
- First published astronomical discoveries made using unsupervised machine learning techniques in the 1980s
- First AI to control a spacecraft in deep space in 1990s
- First AI to plan the work of robots on another planet in 2000s
- First AI to hold a conversation with astronauts in space in 2000s
- The Quantum AI Lab which was co-founded in 2012
- Deep neural network that validates over 300 new exoplanets in 2021
- AI models used by airlines to reroute aircraft in order to reduce fuel use and emissions during 2022-2024
- GenAI Lab for Science & Engineering co-founded in 2024
- Geospatial foundation models for landmass and weather



USRA experience supports the future of space research and exploration with AI as the tool to make so much possible. Here, Hubble sees legions of galaxies. Image Courtesy: NASA Goddard/2017-12-08

Today, USRA delivers vast AI capabilities

USRA's AI capabilities directly advance the Genesis Mission — the national initiative to double U.S. scientific productivity through AI — and align with NASA Science Cloud's vision of open, scalable infrastructure for science.



Air and Water Quality

- Real-time AQ alerts



Disaster Recovery Agents

- Flood Detection



Agriculture & Food Security

- Space weather for GPS
[precision agriculture]



Energy & Carbon Management

- GHG Alerts



Weather & Climate Resilience

- Contrail Forecasts
- Disaster Response
- Wildfires



Space Weather

- Solar flares & filaments
- Solar wind forecasting



Space Life Science

- Space Life Science data archive
- Astronaut health monitoring



Space Prospecting & Geology

- Remote sensing surveys for ISRU
- Robotic sample science for ISRU



Astrophysics & Astronomy

- Astronomical discoveries &
planet hunting



Space & Air Traffic Management

- AI-Enabled Collaborative Digital
Departure Rerouting System



Optimization & ML

- Equip autonomous systems
- Integrate quantum sensing
& networks



Hardware Architectures

- Underexplored designs &
implementation strategies of
quantum systems



Quantum Simulation

- Simulate high-dimensional,
non-linear system of PDEs
forward & reverse



HPC & Benchmarking

- Real-world performance
expectations of a QC solution



Quantum Sensing Theory & Design

- Quantum sensor designs to reach
the Heisenberg limit

USRA's AI Innovation Portfolio

USRA develops applied AI systems that help government, research, and operational stakeholders transform Earth observation data into actionable intelligence. Working with NASA, NOAA, USGS, DOE, and international partners, USRA advances AI capabilities across water monitoring, aviation weather, extreme weather analysis, and land intelligence.

For water monitoring, USRA developed SAM2 Water with the USGS Water Resources Mission Area, a fine-tuned version of Meta's Segment Anything Model 2 optimized to identify water features in satellite imagery with greater speed and precision.

In aviation weather, USRA created a physics- and machine learning-based Contrail Prediction and Observation System through DOE's ARPA-E program. Using high-resolution atmospheric data and global satellite observations, the model predicts persistent contrail formation.

USRA also partnered with NASA and BCG X to develop GAIA, a foundation model trained on 25 years of global weather satellite data to support precipitation estimation and extreme weather tracking.

Through NASA's IMPACT program, USRA contributed to Prithvi EO-2, an open Earth observation foundation model supporting flood, wildfire, and damage assessment applications.

