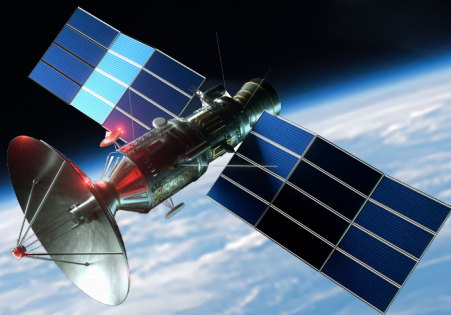# HUMAN-CENTERED ENGINEERED SOLUTIONS

F O R

SPACE

ENHANCING SPACE DOMAIN AWARENESS

charles river analytics

Our pioneering research in machine learning, data mining, and natural language processing has led us to create novel, hybrid AI tools and innovative architectures that provide cost-effective and tailored solutions to the complex challenges facing the space community today.

With these tools, customers can monitor, assess, and act with confidence to maintain critical space assets and ensure multidomain success.

Mission success is critical to preserving strategic advantage.

Charles River Analytics understands the challenges.

In the dynamic and complex space environment, challenges abound—from navigating an increasing debris field, to coordinating satellites with diverse missions and accurately simulating high-pressure real-time scenarios—challenges that demand revolutionary technology for bold and thoughtful solutions.

With a keen focus on human-centered systems, we harness an array of advanced R&D as well as Scruff™, our probabilistic programming language, to serve the needs of both the Department of Defense and the commercial sector, ensuring effective and impactful solutions for the space industry.
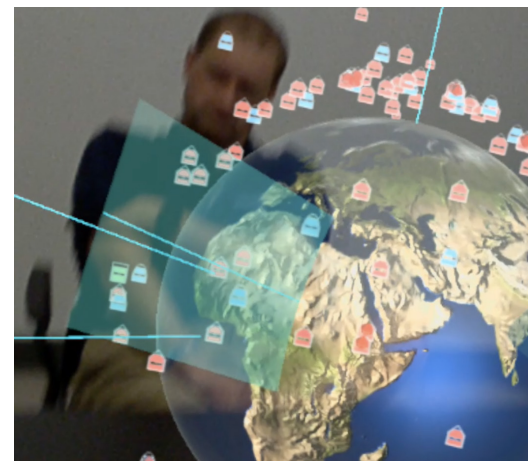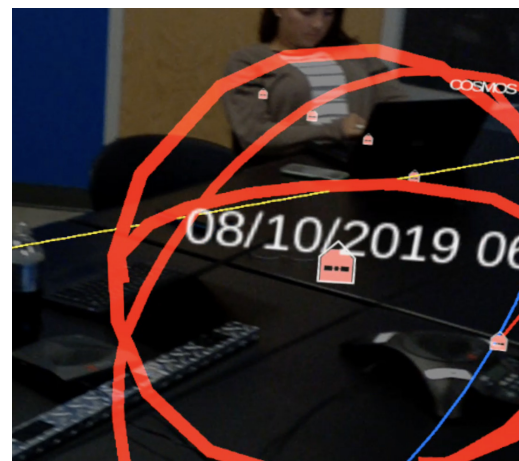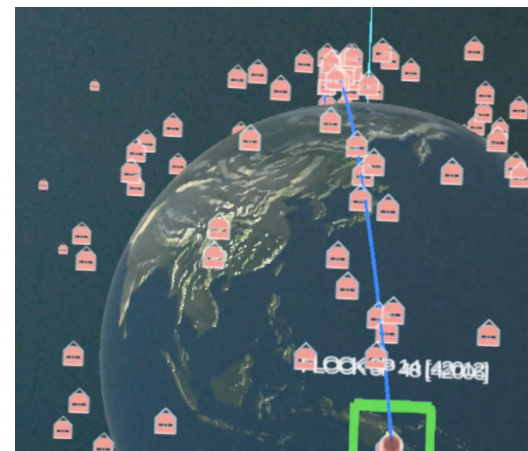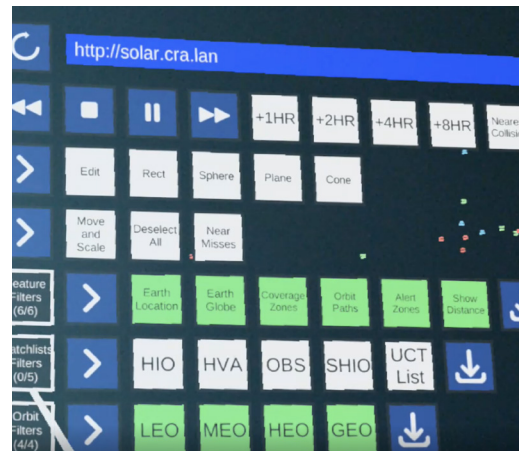
At Charles River Analytics, our innovative spirit and technological expertise deliver solutions for the intricate choreography of space operations.

Space Domain Awareness

The sheer volume of space debris makes space domain awareness (SDA) a challenge. Add the growing number of satellites, all with varying objectives and capabilities, and it complicates the picture even more. Space is dynamic, with complex 4D geographies. We use relevant data to develop user-friendly tools to teach and retain SDA concepts.

Astronaut Support

Tools from Charles River Analytics allow astronauts to manage their tasks to avoid cognitive overload on missions. Unobtrusive physiological sensors assess and predict changes in response to changing environments. These tools help design more effective and astronaut-friendly systems.

Autonomous Operations

Uncrewed space missions require systems that can complete tasks with little to no human intervention. Our AI works within robotic teams to coordinate and communicate for task allocation. We've also delivered systems that can autonomously detect and mitigate faults on space platforms, improving their resilience.

Threat Analysis

Our tools use modeling and simulation techniques to help analysts better understand the most likely and most significant threats. Our AI processes high-volume, multisource data input to provide informed and actionable information for battle management command and control.

Command and Control

Successful missions start with the right strategies to support multidomain operations. We deliver tools that optimize limited antenna resources from satellites and prioritize data relayed from space with an understanding of the operational context to recommend the most efficient courses of action in the most challenging situations.

Operations Support

We provide extensive support to space operations through our suite of solutions, offering advanced tools tailored to the domain. With our user-friendly and leading-edge technologies, we further empower space professionals, leading to increased efficiency and successful space missions.

KWYN™ SOLAR

An immersive environment for rapidly understanding the space domain

With **KWYN SOLAR**, our AR/VR immersive environment, operators can step into the current space picture to explore satellites. KWYN SOLAR's training techniques include immersive, interactive, and collaborative engagement with representative space scenarios, making space domain concepts easy to learn and easy to retain. Within synchronized AR/VR overlays and 3D satellite models, operators can use outputs from novel AI and advanced analytic tools to protect their assets from collisions and improve threat detection. Charles River, in collaboration with the DARPA Hallmark program, developed this leading-edge technology to enrich SDA understanding.

APOGEE

Extended reality (XR) for space domain awareness and BMC2

With Apogee, operators can make intelligent, speedy decisions in the space domain from accurate models of resident space objects and their orbital mechanics based on real-time data.

ASTER

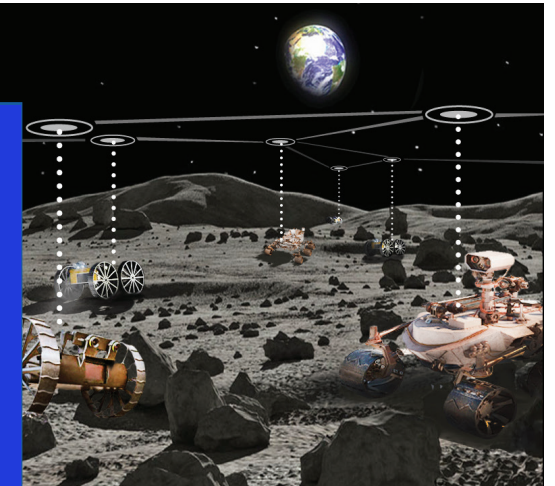## A system to explore cooperation and behavior allocation of autonomous teams

ASTER improves swarm autonomy and coordination for robot systems exploring the Moon. It combines the Swarm Coordination Framework developed at Charles River Analytics and the Buzz Programming Language developed by Dr. Carlo Pinciroli at Worcester Polytechnic Institute's Nest Lab to give robot teams the ability to divvy up tasks among themselves, with each robot recognizing which job it can do best, given what it knows about the available tasks and all the other robotic vehicles on its team.

ASTER
Autonomous swarming for teams of planetary exploration robots
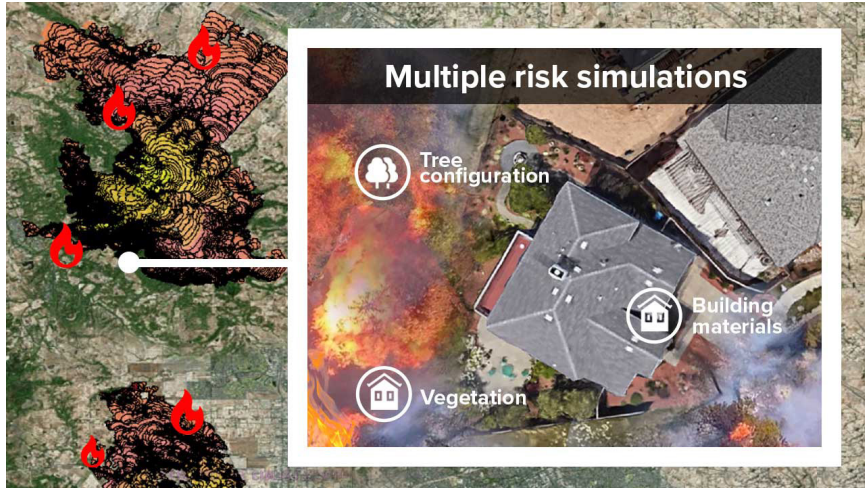
Enabling swarms to:

- Respond autonomously to unexpected situations
- Determine which vehicle has the right capabilities for the task
- Manage faults as vehicles degrade

ASTER explores cooperation and behavior allocation for autonomous teams of robotic vehicles to assist NASA's lunar programs, such as Artemis and CADRE. Multirobot systems working together on exploration missions will help lead the way for a sustained human presence on the Moon.

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WIMPLE
A tool to explore cooperation and behavior allocation of autonomous teams

Multiple risk simulations — Tree configuration, Building materials, Vegetation

This innovative climate tool enables precise wildfire risk assessment on a parcel-by-parcel level, facilitating proactive threat planning and risk reduction strategies. WIMPLE harnesses valuable data sources, leveraging the robust capabilities of NASA Earth Observatory and NASA Visible Earth. The user-friendly interface translates complex insights into accessible predictions and recommendations, fostering comprehensive understanding and engagement among all stakeholders.
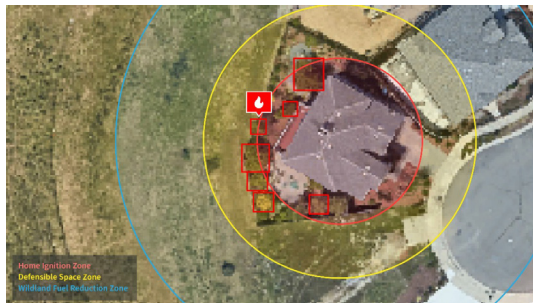

Property view with vulnerability zones and mitigation suggestions

CAPT PICARD
A system to measure cognitive workload during training and on the job

Charles River worked with NASA to assess astronaut workload and performance during the testing and evaluation of new systems. CAPT PICARD, an unobtrusive suite of sensors, comprehensively measures, assesses, and predicts astronaut cognitive workload to indicate when steps should be taken to augment cognitive readiness. Conducting workload assessment during developmental testing of a new system allows teams to identify features and designs that result in high workload early in the process, when redesigns are more feasible and less costly.

Forehead Sensor Suite — Raw Data Streams, Processed Data Streams
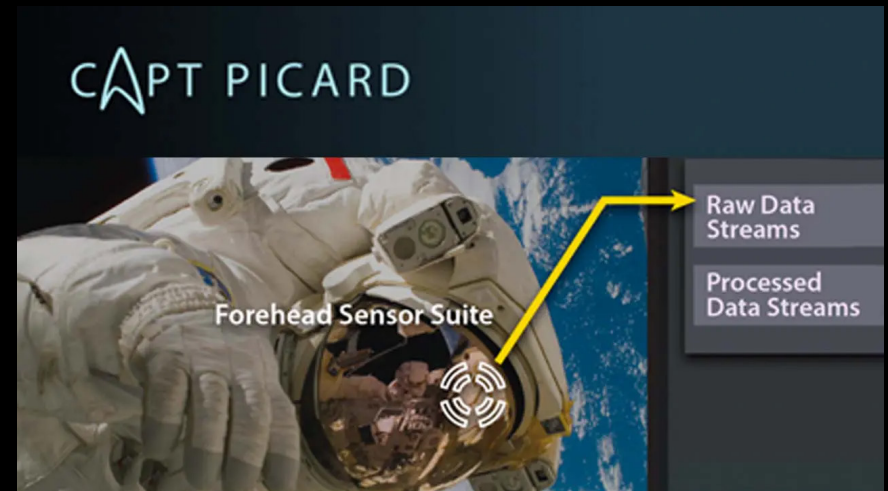
CAPT PICARD can inform astronauts and Mission Control when cognitive performance begins to deteriorate, averting performance-related crises during a space mission.

PICASSA

A system to explore cooperation and behavior allocation of autonomous teams

Artist's Concept

Under the DARPA Hallmark program, Charles River and our partners at Operational Intelligence, LLC, and the Space Strategies Center developed the PICASSA tool to better understand the space environment. DARPA's Hallmark program aims to enable warfighters to collect, analyze, and interpret space domain awareness (SDA) data to make better decisions in the ever-changing space environment.
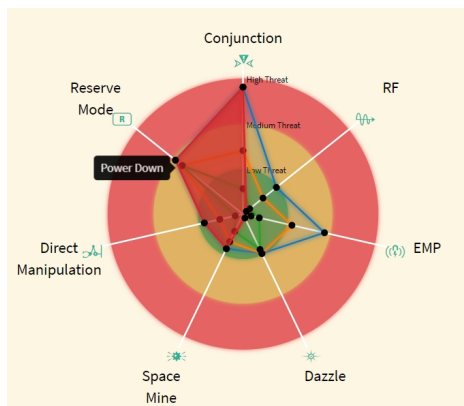
Charles River's PICASSA tool produces more accurate, enhanced threat indicators by fusing SDA data in a probabilistic model. PICASSA escalates notifications about potential threats in space, allowing Commanders to better understand the ramifications of potential courses of action (COAs) that respond to threats in space.

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Solutions to serve the warfighter, technology to serve the world®

Charles River Analytics uniquely combines agile innovation and leading-edge research with a decades-long track record of hardened engineering in austere environments to create best-in-class solutions to diverse, challenging problems.

We were founded in 1983 to perform results-focused research for the US Government. In 2012, we became a 100% employee-owned company, setting the stage for the next generation of innovation, service, and growth.

Decades of government-funded innovation have generated an extraordinary breadth of core IP, which we harness to create an ongoing stream of breakthrough research.

The tools we develop maximize a trainee's transfer of skills through ecological mapping of real-world scenarios to computer-generated training scenarios, reducing training equipment, development, execution, and maintenance costs.

Our immersive applications place trainees in gamified environments that are realistically rendered. To optimize training, we measure physiological signals and the cognitive workload of each trainee to create adaptive curricula tailored to each individual.
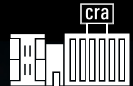
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Employee-Owned Small Business