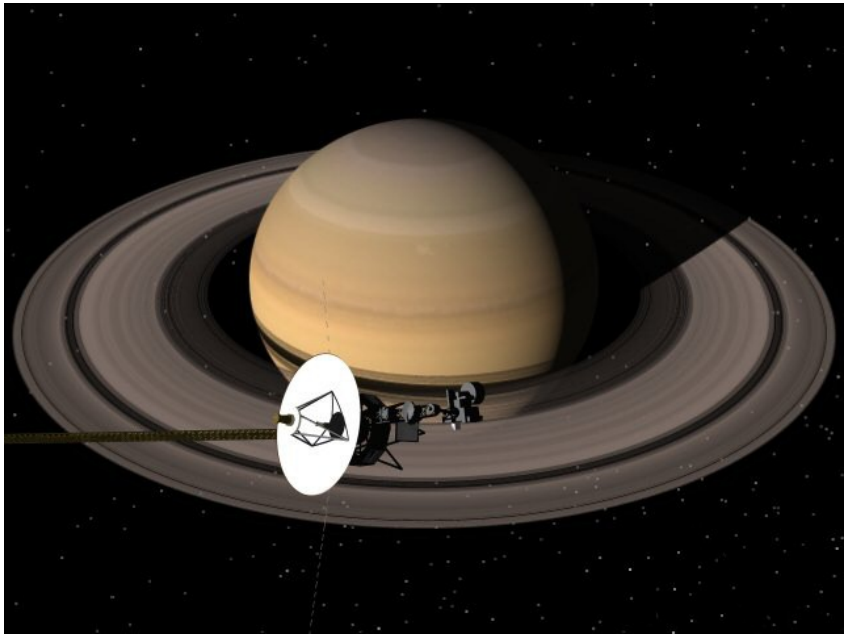
AI Planning for Space

Images: ESA, NASA, ArianeSpace

Applications of AI Planning for Space

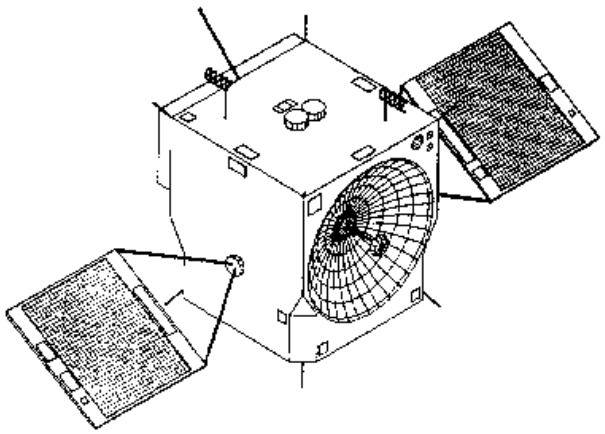
- Deviser – Voyager mission planning demonstration
- Optimum-AIV – Ariane Assembly, Integration & Test
- Ground Segment Planning and Control
- Telecommand of Meteorological Satellites
- Technology Proving & Autonomous Spacecraft
- European Space Agency Planners
- NASA Planners
- Deep Space 1 – RAX – to boldly go…

Early Spacecraft AI Planning Application



- Deviser
- NASA Jet Propulsion Lab
- Steven Vere, JPL
- First NASA AI Planner
- 1982-3
- Based on Nonlin
- Added Time Windows
- Produced Voyager Mission Plans
- Not used live, example use for Uranus encounter

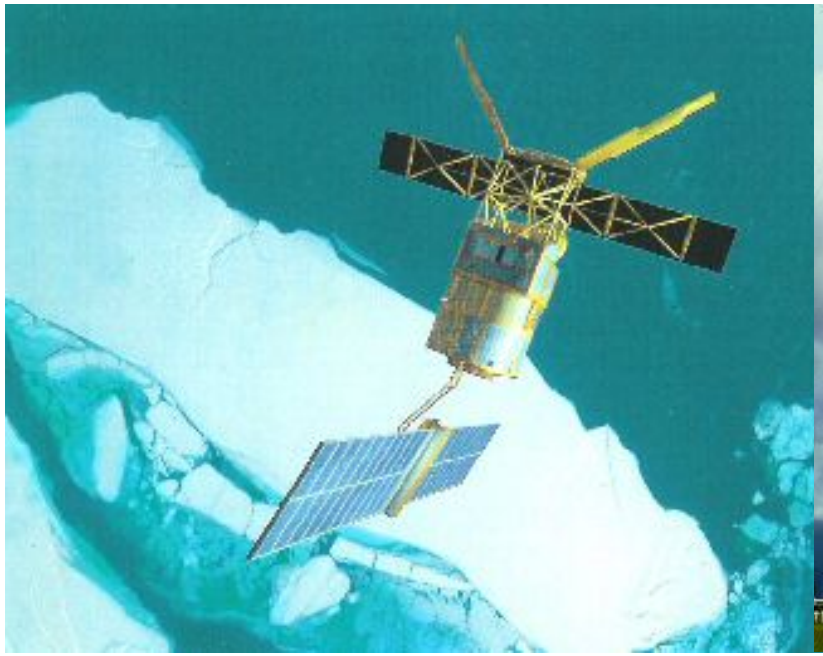
Early Spacecraft AI Planning Application



T-SAT Concept

- British National Space Centre
- T-SAT Technology Proving Spacecraft Project 1989
- Edinburgh T-SCHED Planner
- Brian Drabble, AIAI, University of Edinburgh
- Ground-based plan generation
- 24 hour plan created, uploaded and executed live onboard UoSAT-II

ESA – PlanERS-1 and Optimum-AIV



Photos: ESA, ArianeSpace

ESA Spacecraft Planning Applications

- **APSI** – Advanced Planning & Scheduling Initiative
- AI, scheduling, constraint programming

- **MEXAR2 and RAXEM** – Advanced Planning for Spacecraft Data Downlink and Telecommands Uplink
- AI, mixed-initiative, scheduling, flow-network

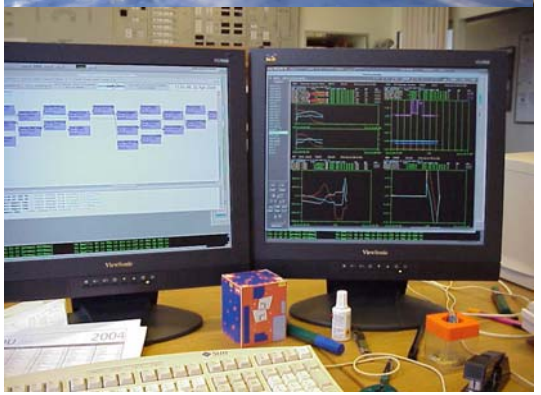
- **SKeyP** – SOHO Keyhole Planner
- AI, scheduling, constraint programming

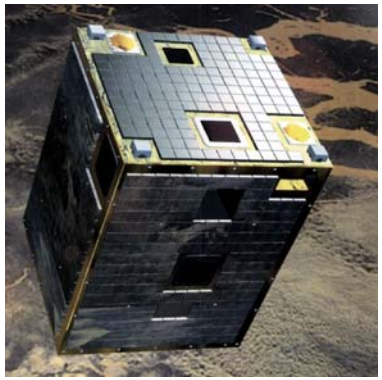
- **MrSPOCK** – Mars Express Science Planning Opportunities Construction Kit
- genetic algorithms, heuristic search

- **More on ESA Spacecraft Operations Web Sites**

ESA PROBA

- Project for On Board Autonomy
- Proba-1 launched in 2001
- Demonstrates the potential and feasibility of small satellites for advanced scientific and Earth Observation missions
- Controlled by an automated ground system



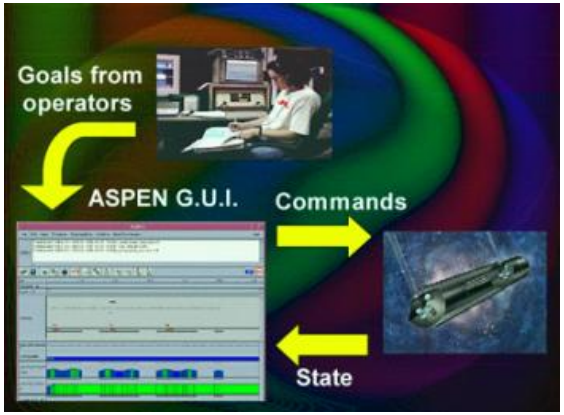


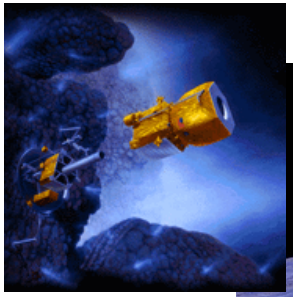
More on ESA's PROBA Web Site

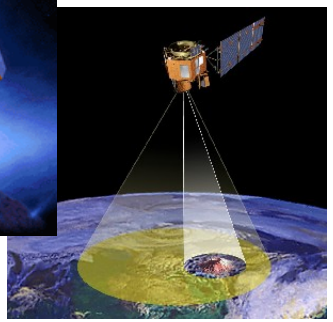
Images: ESA

NASA Spacecraft Planning Applications

- **ASPEN** – Automated Scheduling and Planning ENvironment – is a software framework which provides a reusable, reconfigurable library of components for typical planning applications.
- **CASPER –** Continuous Activity Scheduling Planning Execution and Replanning – uses iterative repair to support continuous modification and updating of a current working plan in light of changing operating context.
- **ASE** – Autonomous Sciencecraft Experiment – uses on-board science analysis and replanning to radically increase science return by enabling intelligent downlink selection and autonomous retargeting.
- **EUROPA** – a a framework to model and tackle problems in Planning, Scheduling and Constraint Programming.
- **More on NASA JPL AI Group and NASA Ames Intelligent Systems Group Web Sites**







Images: NASA

NASA Mars Exploration Lab - Curiosity

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