Computer Celebrates NASA's 50th Anniversary

Mike Hinchey, Lero—The Irish Software Engineering Research Centre
Paul A. Curto, NASA
Scott Hamilton, *Computer*

A collection of articles emphasizes NASA's contributions to computer science during its 50-year history.

Established in October 1958, NASA is celebrating its 50th anniversary. A significant fraction of *Computer*'s readers are old enough to remember the Apollo 11 mission that landed the first men on the moon, Neil Armstrong and Buzz Aldrin.

We have witnessed the space shuttle era and the building of the International Space Station and have watched with keen interest the results of unmanned missions exploring the planets of our solar system and beyond. The Mars Exploration Rover mission launched in 2003 remains in the news as *Spirit* and *Opportunity* continue their search for geological evidence for life on Mars, and just last month, the Hubble Space Telescope took the first visible light snapshot of the planet Formalhaut b located 25 light-years away.

Over the past decade, *Computer* has followed NASA's achievements in science and, more specifically, computer science. We have published numerous articles on NASA's pioneering efforts in robotics, artificial intelligence, and software engineering. Members of *Computer*'s editorial board have worked with or for NASA agencies, and our editorial staff has visited and written about many research efforts at Ames Research Center, the Jet Propulsion Laboratory, and the Johnson Space Center.

We have come to admire NASA's contributions to our field. In honor of NASA and its many dedicated researchers, we have assembled a collection of articles celebrating 50 years of achievement.

IN THIS ISSUE

In "Universal Systems Language: Lessons Learned from Apollo," Margaret H. Hamilton and William R. Hackler describe USL's origins in their study of Apollo flight software development. Through the ongoing evaluation of the Apollo effort, it became clear that a new kind of language was needed and that mathematical theory could provide its core.

What sets USL apart is the systems paradigm upon which it is based. Whereas traditional software development is curative, testing for errors late into the life cycle, USL's development-before-the-fact philosophy is preventive, not allowing errors in the first place. Correctness is accomplished by the very way a system is defined, by built-in language properties inherent in the grammar. Hamilton received NASA's Exceptional Space Act Award in 2003 for her work on Apollo and later systems.

In "Autonomy for Mars Rovers: Past, Present, and Future," Max Bajracharya, Mark W. Maimone, and Daniel Helmick describe the technical challenges that faced past rover missions—*Sojourner* and the twin

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Mars Exploration Rovers—as well as future missions like the scheduled 2009 Mars Science Laboratory and the planned Mars Sample Return mission. Vehicles used to explore the Martian surface require a high degree of autonomy to navigate challenging and unknown terrain, investigate targets, and detect scientific events. Exceeding by far their expected lifetimes, the MER vehicles' success has raised the bar for autonomous operations in current and future missions.

Finally, "An Integrated Hydrologic Modeling and Data Assimilation Framework" by Sujay Kumar and colleagues illustrates another significant aspect of NASA's mission to support the Earth sciences in understanding natural and human-induced changes on the global environment. The authors describe their Land Information System (LIS) framework, which serves both as a problem-solving environment for hydrologic research and as a decision-support tool for several application areas, including water resources management, numerical weather prediction, agricultural management, air quality, and military mobility assessment. LIS won NASA's 2005 Software of the Year Award.

We hope you enjoy these articles, and we offer our congratulations to NASA for its 50 years of achievement.

Mike Hinchey *is the co-director of Lero—The Irish Software Engineering Research Centre. For six years, he was the director of the NASA Software Engineering Laboratory. Contact him at mike.hinchey@lero.ie.*

Paul A. Curto *is the former chief technologist, NASA Inventions and Contributions Board. Contact him at pcurto@comcast.net.*

Scott Hamilton *is* Computer*'s senior acquisitions editor. Contact him at shamilton@computer.org.*