

ABSTRACT AND BIOGRAPHY

Size, Complexity, and Logic Design for Flight Systems

NASA has historically relied on digital logic. The first digital computer on a manned mission was on Gemini and NASA astronauts have increasingly relied on digital computers since on the Apollo program as well as the fly-by-wire Space Shuttle. Early unmanned missions relied on sequencers with increasingly more powerful computers used on spacecraft, landers, and rovers.

Digital logic technology has increased the capacity of integrated circuits over the past 50 years at a geometric rate. With devices now containing 100s of thousands of gates, engineers can build systems with more functions and higher complexity, in a smaller footprint. The increased sophistication of these devices does not directly translate into more complex designs however. One can design large "simple" systems, as well as small "complex" ones.

This talk will begin with a discussion of complexity and how it is applied to digital logic design on various programs. It has become cliché for many programs to claim a design to be complex, but what does it mean when a given digital logic design is said to be "complex"? An attempt will be made to formalize its definition.

This talk will then explore the relationships between complexity, device size, and the technologies and methods employed to tackle complexity. These include engineering practices and methods, tools, and device architecture. This talk will use case studies as a backdrop to demonstrate that complexity is often a function of the design, and not size, and how complexity can be managed.

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Rich received his B.S. in Computer Science and Applied Mathematics, at the State University of New York at Stony Brook in 1982. The following year he received an M.S. degree in Electrical Engineering, also from SUNY at Stony Brook, specializing in digital electronics and computer engineering.

Subsequently Rich joined NASA's Jet Propulsion Laboratory in 1984 performing digital design for the Galileo mission to Jupiter and served as lead design engineer for the Digital Units on Magellan to Venus, responsible for the digital logic portions of the synthetic aperture radar, altimeter, and radiometer.

Following a year in the commercial electronics sector, Rich returned to NASA in 1989, at the NASA Goddard Space Flight Center, continuing in the design, analysis, build, and test of spaceflight electronics for a variety of science missions, ranging from low Earth orbit spacecraft to Mercury to Mars to Saturn to Pluto.

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Rich's activities also include failure analyses and mishap investigations, and has organized and led an on-going seminar/workshop series ranging from tutorials to state-of-the-art research topics, initiated and led the annual MAPLD International Conference, and authored Design Guidelines and Criteria for Space Flight Digital Electronics along with related notes, papers, and reports. Rich provides consulting to various NASA Centers, and the Department of Defense, providing reviews and guidance in the application of digital circuits for motor and explosive initiation applications.

Rich's current research interests include the design of high-reliability circuits, the use of programmable elements and devices in space-flight applications, and high-performance digital microelectronics. A related technical interest is the design, application, and reliability of digital logic circuits and systems of the 1960s.