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Airliner Engine Design Code Wins R&D 100 Award for Southwest Research Institute

A software design code, developed for the Federal Aviation Administration (FAA) by Southwest Research Institute (SwRI) to help engine manufacturers improve the safety of jet engines used in commercial airliners, was named one of the 100 top technical achievements of the past year by *R&D Magazine*. The award was presented in Chicago on 27 September 2000.

Engineers and scientists who developed the R&D 100 Award-winning software code DARWIN are (clockwise, from left) Dr. Craig McClung, Chris Kuhlman, Dr. Michael Enright, Dr. Gerald Leverant, Dr. Harry Millwater, Dr. Grahman Chell, David Riha, and Dr. Yi-der Lee, all from the Institute's Mechanical and Materials Engineering Division.

DARWIN (Design Assessment of Reliability with Inspection) was developed with support from commercial gas turbine engine manufacturers Rolls Royce, Pratt & Whitney, Honeywell, and GE Aircraft Engines, and the Rotor Integrity Subcommittee (RISC) of the Aerospace Industries Association. The FAA has authorized SwRI to make DARWIN commercially available under license starting in 2001.

The software code is used to assess the risk that a jet engine's titanium rotor disk might contain a dangerous metallurgical flaw that could cause fatigue cracking, leading to possible catastrophic failure. DARWIN integrates finite element stress analysis results, fracture mechanics-based life assessment for low-cycle fatigue, material anomaly data, probability of anomaly detection, and inspection schedules to determine the probability of fracture of a rotor disk as a function of aircraft flights. Its use is expected to reduce the risk of catastrophic turbine rotor failure by as much as an order of magnitude for new designs.

"DARWIN is an integral part of the Federal Aviation Administration's strategic plan to reduce the U.S. aviation accident rate by reducing the failure rate of rotor disks in commercial aircraft turbine engines. We are pleased to play a significant part in the FAA's plan to make flying even safer than it already is," said Dr. Harry R. Millwater, Jr., principal engineer in the SwRI's Mechanical and Materials Processing Division.

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Innovative Use of Equipment and Consumables Increases Weld Fatigue Life by a Factor of 10

A recently completed program provides keys to prolonging the life of mining, construction, transportation, and other heavy industrial equipment welded joints.

The Lincoln Electric Company, Caterpillar, Tower Automotive, and U.S. Steel Group completed last year, a four-year joint venture program to research ways of increasing the fatigue life of welded joints. Fabrication of Advanced Structures Using Intelligent and Synergistic Processing (FASIP) was funded in part through a $10 million grant through the National Institute of Standards and Technology's Advanced Technology Program. As part of this program, Lincoln Electric developed technology to increase weld fatigue life by a factor of 10 and also reduce the overall weight of the component.

Lincoln's involvement with FASIP focused on the welding process and controlling certain aspects of that process to improve weld fatigue life. The project established new technology and associated methodology to significantly improve weld fatigue life over conventional welding practices. This new technology provides a means to significantly elevate the resistance of the weld to fatigue cracking by reducing the stress concentration effects associated with the weld and by eliminating defects and discontinuities. New consumables and equipment are now available to help in these efforts.