

Advancing Fracture Science with FRASTA

SRI's FRActure Surface Topography Analysis (FRASTA) technology is a leapfrog advance in fracture science. FRASTA can determine the growth history of a crack that caused an aging structure to fail, and assist in the development of computational models for predicting remaining useful life.

By quantifying, juxtaposing, and incrementally displacing topographs of conjugate fracture surfaces, the deformation at the crack tip is characterized and a fracture event can be reconstructed in detail. FRASTA reveals how a crack front interacts with microstructural features and thus is useful in developing tougher materials.

The SRI-developed FRASTAscope, a confocal optics instrument that has been commercially marketed, produces topographic maps of fracture surfaces, manipulates the

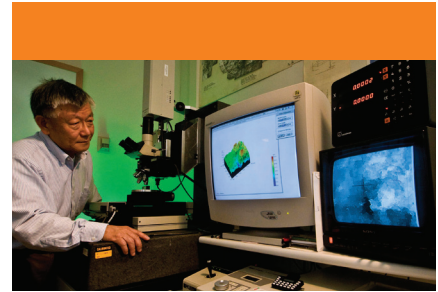
conjugate topographs, and displays images of crack growth and micro-failure evolution.

A major step forward from conventional qualitative fractography, FRASTA improves current failure prognosis and diagnosis capabilities.

Diagnosing and predicting fatigue failure through quantitative 3D fractography

Aging Structures

With FRASTA technology, SRI estimated the time it took for a crack to appear in a 22-year-old boiler tube of a fossil-fired power plant,



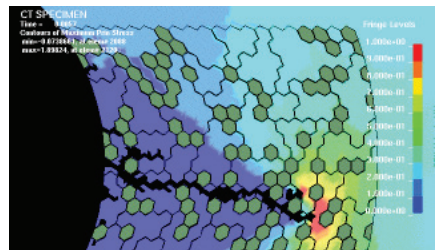
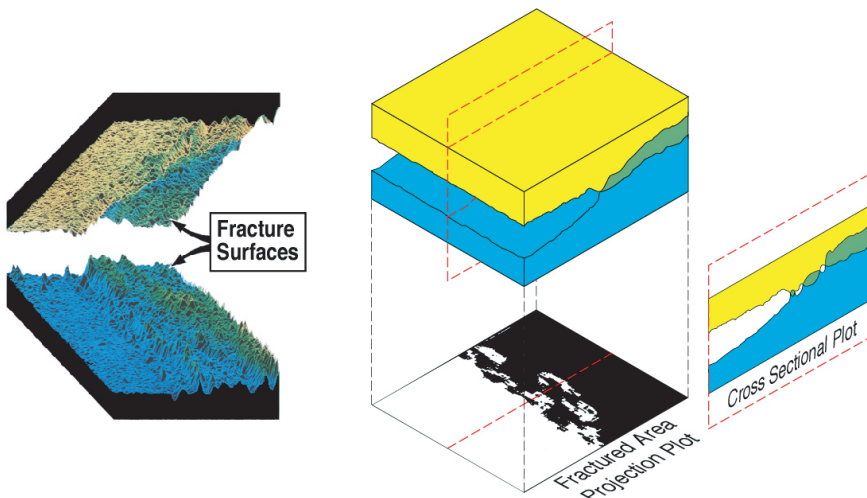
and gave the history of the crack's growth. This information helped the plant operator set inspection intervals and plan for repair, rehabilitation, and component replacement. FRASTA also replays fatigue crack growth in pipelines, bridges, and aircraft fuselages and engines.



Aging pipes and vessels in an oil refinery

Predicting Remaining Useful Life

By reconstructing microscopic details of deformation and failure occurring at a crack front, FRASTA produces data useful in developing and vetting computational prognostic crack growth models. Such physics-based models aim to enable more reliable predictions of a structure's remaining useful life.



Topographic maps of conjugate fracture surfaces are created, juxtaposed, and incrementally separated to reconstruct details of the fracture process

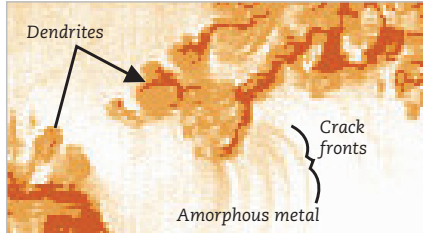


FRASTA can replay fatigue crack growth in aging bridges



New Materials

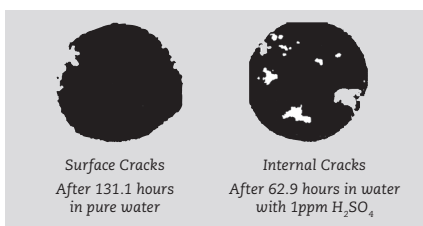
Metallic glasses, a new class of materials without crystalline grains, are produced by quenching special compositions from the melt. SRI is applying FRASTA to unlock the secrets of the remarkable fracture properties of these materials. SRI also helps materials scientists design particle-toughened materials by applying FRASTA to show how a crack front interacts with the particles.



Fracture surface of an amorphous metal

Failure Mechanisms

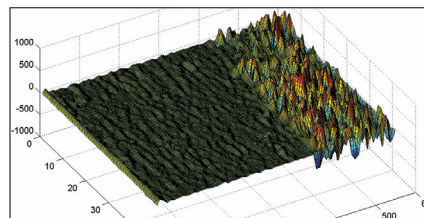
Post-test analysis with FRASTA has distinguished the mechanisms responsible for stress corrosion cracking of nuclear-grade stainless steel in pure and contaminated water. FRASTA is being used to investigate hydrogen-assisted crack nucleation in steels.



Microfailure evolution in stainless steel under different environments

The Future of FRASTA

SRI continues to extend three-dimensional fracture surface analysis and seek faster, more efficient, and higher-resolution methods to quantify and interpret fracture surface topography. Fourier, wavelet, and discrete cosine transformation techniques are being applied to analyze fractographic data and extract additional information from fracture surfaces. Key goals are to deduce load conditions responsible for failures and to quantify the crack nucleation process.



Wavelet representation of fracture surface

Contact Us

Donald Shockey
Director, Center for Fracture Physics
650.859.2587
Fax 650.859.2343
donald.shockey@sri.com

<http://www.sri.com/fracture>

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Headquarters: Silicon Valley

SRI International

333 Ravenswood Avenue
Menlo Park, California 94025-3493
650.859.2000

Washington, D.C.

SRI International

1100 Wilson Blvd., Suite 2800
Arlington, Virginia 22209-3915
703.524.2053

Princeton, NJ

SRI International Sarnoff

201 Washington Road
Princeton, New Jersey 08540-6449
609.734.2000

Additional U.S. and international locations

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Photo at the top right of front page shows SRI's FRASTAScope

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