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Developmental Activities Towards a Real-Time Defect Severity Assessment System for Naval Platforms

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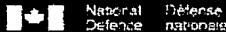

ABSTRACT

The Canadian Navy is developing a rational integrated approach to the design, construction, and maintenance of its ships, in order to maximize operational availability and minimize life-cycle maintenance costs. Naval platforms have been and will be required to conduct operations with cracks present in structural components. The requirement exists to provide the operators with a measure of confidence that these defects do not pose a serious risk to structural integrity. To assist in these efforts, Defence Research Establishment Atlantic (DREA), in collaboration with Fleet Technology Ltd (FTL), have undertaken numerous fatigue studies to develop a clearer understanding of the factors that govern fatigue in naval platforms. In addition, DREA and FTL have worked in close collaboration with the Directorate of Maritime Ship Support (DMSS) and the Naval Engineering test Establishment (NETE) on numerous experimental investigations of fatigue prone areas on existing naval platforms. As a consequence of these efforts, it was realized that the development of a shipboard system for the continuous monitoring of detected fatigue cracks and their associated driving forces could provide operators with a continuous measure of the defects severity and the structural integrity. To this end, a developmental activity to create a Defect Severity Assessment System (DSAS) was initiated. This presentation will discuss DSAS developmental activities completed to date, and provide an overview of efforts currently underway.

DEFENCE **RiD** DÉFENSE

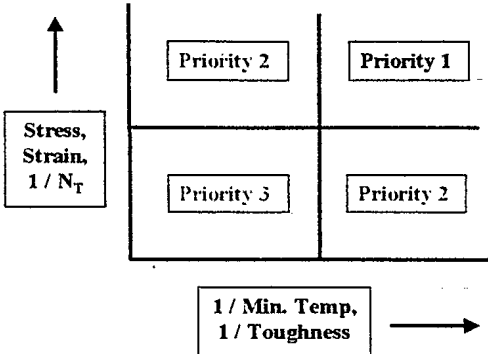
**Developmental Activities Towards a
Real-Time Defect Severity Assessment
System for Naval Platforms**


**John Porter, Chris Bayley, Chris Hargreaves,
Colin Smith, Luksa Luznik**

Rational Maintenance Protocols

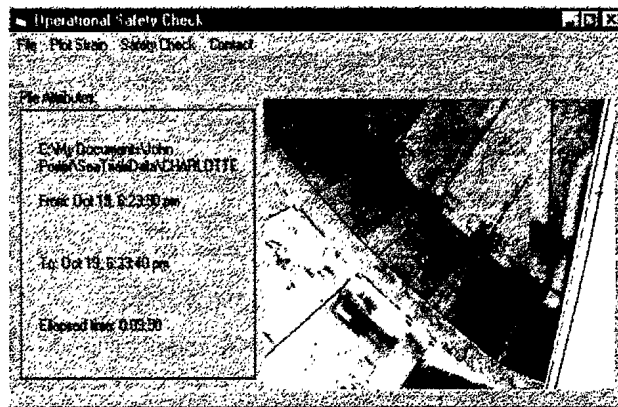
- **Priority 1 - Repair**
- **Priority 2 - Apply DSAS, ISSMM, etc.**
- **Priority 3 - Defer or schedule repairs**





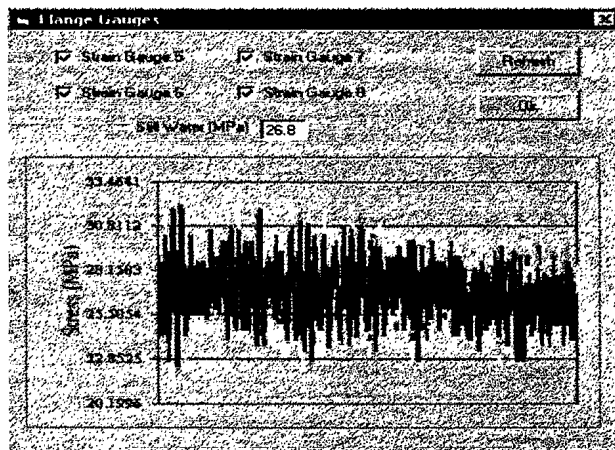
Defence Research Establishment Atlantic (DREA)

Defect Severity Assessment System "Conception"



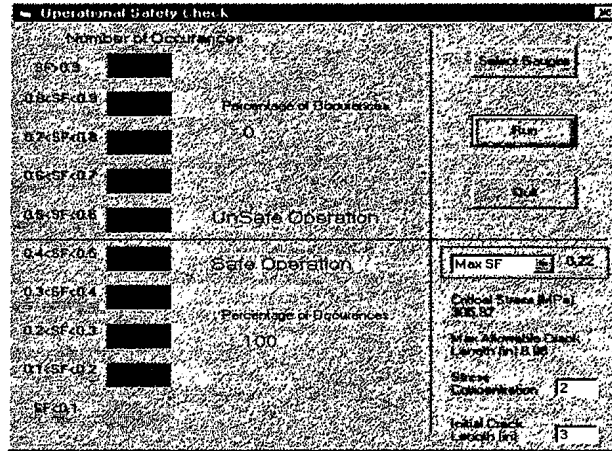
Defence Research Establishment Atlantic (DREA)

DSAS Stress Spectrum



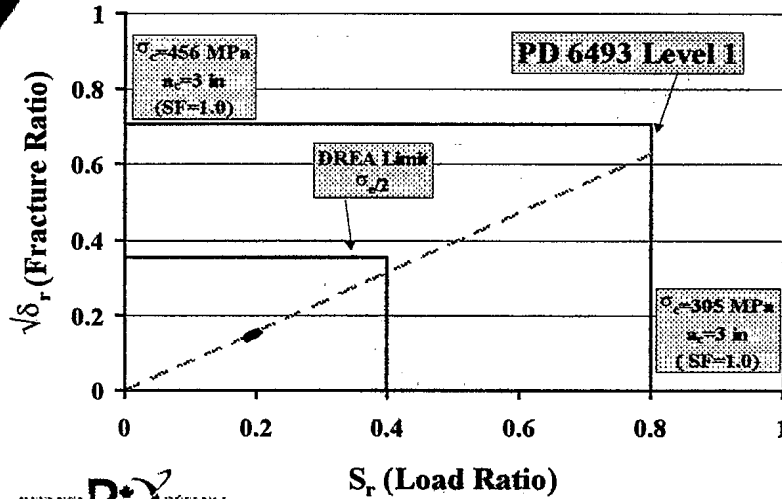
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DSAS Severity Factor



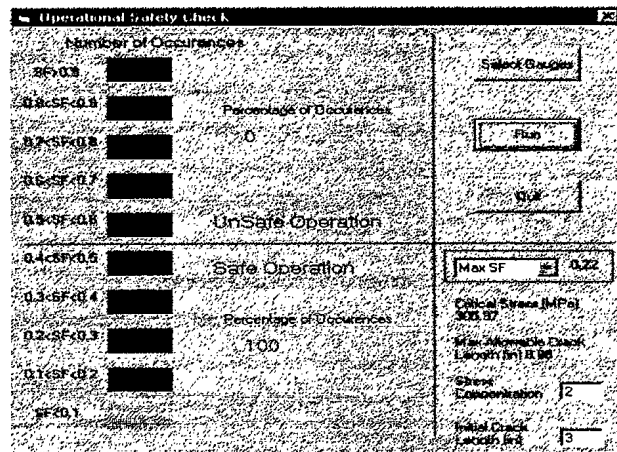
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Severity Factor Assessment



Defence Research Establishment Atlantic (DREA)

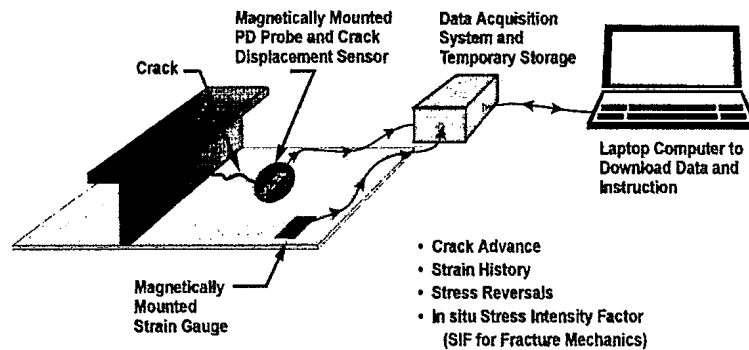
DSAS Severity Factor



Defect Severity Assessment System Development Project Objectives

- Provide operators with real-time assessment of defect severity,
- Facilitate ship-board fatigue experimentation,
- Advance knowledge base of fatigue in complex welded structures.

Defect Severity Assessment System Overview

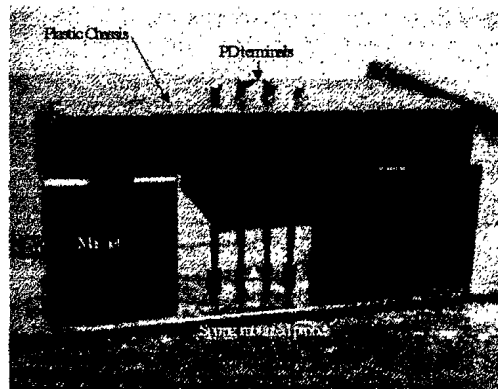


Defect Severity Assessment System Current Objectives

- **Continuous monitoring of crack length**
- **Quick installation strain monitoring**
- **Crack opening displacement monitoring**
- **Advanced severity assessment**
- **CPF sea trials (Fall / 99)**

Potential Drop Crack Length Probe

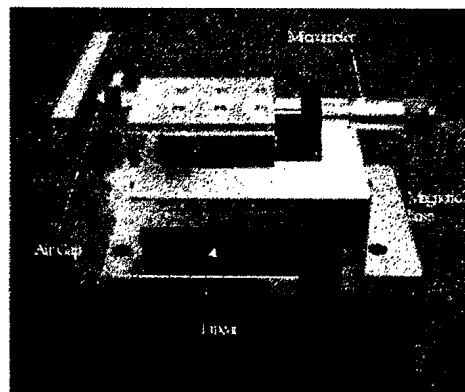
- Continuous calibrated monitoring
- Magnetically mounted
- Response comparable to spot-welded probes



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Capacitive Strain Sensor

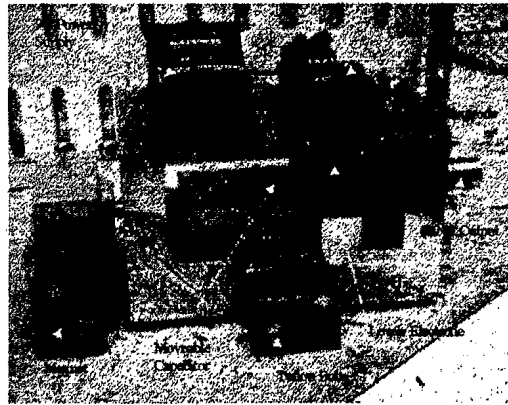
- Parallel plate capacitive sensor
- Magnetically mounted
- Very high sensitivity (comparable to conventional strain gage)



Defence Research Establishment Atlantic (DREA)

Capacitive Displacement Sensor

- Varying dielectric sensor
- Magnetically mounted
- Linear response
- Variable sensitivity



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Advanced Severity Assessment

- Direct incorporation of motion and location data;
 - Relating environment to severity factors
 - Learning and forecasting capabilities
- Additional defect severity definitions;
 - PD6493 Level 2
 - Direct crack opening definitions



Defence Research Establishment Atlantic (DREA)

Conclusion

- **Defect Severity Assessment System proof of concept successfully established**
- **Ongoing developments include novel ways of monitoring strain and crack advance, and defining defect severity**



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This was the eighth naval materials CF/CRAD (Canadian Forces/Chief Research and Development) meeting. These meetings have been held every two years since 1985. The first four meetings were devoted to fabrication and inspection of submarine pressure hulls with sessions on welding, inspection and fracture. The last four have expanded to include all aspects of naval materials.

The purpose of these meetings has been to bring together industrial research contractors, university contractors, defence scientists, and NDHQ (National Defence Headquarters) design authorities from the naval materials technology area and invited scientists and engineers from other countries to share advances in naval materials technology in a conference like setting.

The program includes Welding and Laser Surface Modification, Environmental Research, Corrosion and Coatings, Vibroacoustic Materials, Ship Fracture, Fatigue, Firesafe Materials, Non-Destructive Evaluation, Metallurgy and Failure Analysis, Organic Materials (Polymers), Fuels and Lubricants and Naval Consulting.

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