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INJURY AND CRASH ANALYSIS, LLC

**ANGELA TREGO, Ph. D., P.E.**

**PROFESSIONAL LICENSE**

Washington State Professional Engineer Ref: 35623 99

**PATENTS**

**Vehicle Condition Monitoring** 04  
A. Trego, E. Haugse, R. Ikegami US 06691007  
**Material Removal Rate Fiber Optic Corrosion Sensor** 00  
E. Udd, A. Trego and E. Haugse US 06144026  
**Fiber Optic Overheat Detection Blanket** Pending  
A. Trego, R. Wright  
**Structural Health Monitoring Architecture using Sensor Technology** Pending  
A. Trego, E. Haugse, A. Akdeniz, D. Anderson, C. Greenberg

**PROFESSIONAL EXPERIENCE**

**Manager** 05 - present  
Becton Dickenson Medical  
Tasks include:  
• Organizing and created engineering services group across R&D Medical / Surgical division. Managed 45 individuals with expertise in industrial design, molding, packaging, labeling, fixture design as well as the laboratory and all associated regulatory compliances.

**Lead Engineer** 03 - 05  
Phantom Works - Structures, Boeing  
Tasks include:  
• Structural IVHM Team Leader for Advanced Support Concepts Thrust. In charge of technology development, budgets, and personnel.  
• Aging Aircraft Team Leader for Phantom Works. One of six team leaders across the Boeing Company and the only non-manager of the team leaders. This is an enterprise wide team defining the state of the art in structural life assessment and enhancement, maintenance and utilization of aging aerospace platforms. Responsible for the effective and efficient transition and integration of multiple advanced technologies into robust and reliable methods and practices ensuring the safe operation of Boeing products throughout their economic life.  
• 787 Technical Lead for the development of an onboard structural health monitoring system for the new airplane development team. Responsibilities include developing and evaluating new technologies and presenting this information to management. Technologies include impact detection, damage detection and environmental damage for composite and metallic aircraft. Congruently, a flight qualified battery

operated health monitoring system was developed which was retrofitted onto existing commercial airplanes.

- Program manager for joint research effort with Australian government research agencies, CSIRO and DSTO developing corrosion prognostic algorithms.
- Member of various proposal and non-advocate teams.
- College recruiting including interviewing students for prospective jobs, scholarships and internships and interfacing with both the Society of Women Engineers and American Society of Mechanical Engineering chapters.

### **Senior Specialist Engineer**

97 - 03

Phantom Works - Structures, Boeing

Tasks include:

- Principal investigator, including liaison, program management and subcontract management, for the X-34 Acoustic Emissions Structural Health Monitoring System Experiment. Provided customer interface, experiment analysis and presentation of final report to NASA Marshall. Integrated a flight qualified experiment onto the X-34 developed by Orbital Science Corporation.
- Principal investigator / technical lead, for the Internal Research and Development program overseeing remote NDI sensor development and autonomous corrosion monitoring for maintenance and modification repairs.
- Program manager / technical lead, including responsibility for statement of work, program budget and scheduling over several fiber optic health monitoring SBIR contracts. Developed new health monitoring technology using fiber optics.
- Assisted in developing a corrosion damage assessment framework for the USAF, including performing crack growth analysis and risk analysis to model fatigue cracking due to corrosion. Interfaced with the customer, maintenance crews and university consultants.
- Performed dynamic modal analysis using PATRAN and NASTRAN for various programs including JSF, B-52, Sea Launch, TRAM II, and the Space Station.

### **Project Engineer**

01 - Present

Injury and Crash Analysis

Teaching short course for under ride analysis to a variety of disciplines including lawyers, accident re-constructionists and policemen. Provide analysis, consultation, patent litigation and expert testimony regarding fatigue and fracture analysis of materials, finite element analysis, vibration analysis, design analysis, accident reconstruction and accident reconstruction computer modeling.

### **Adjunct Faculty, Dynamics and Thermodynamics**

02 - 03

Mechanical Engineering Dept., Seattle University

Taught junior level thermodynamics and dynamics courses to mechanical and civil engineers. Responsibilities included preparing and giving lectures, homework and tests. Student evaluation rating was 4.23 / 5.00.

### **Instructor, Integrated Product and Process Engineering**

96-97

Mechanical Engineering Dept., Brigham Young University

Faculty coach for two 5 person senior student design teams learning a structured design process while each team worked with a company liaison engineer to solve industrially sponsored and financed, two semester long "design and build" projects.

### **Instructor, Material Science & Associated Laboratory**

96

Mechanical Engineering Dept., Brigham Young University

Developed and taught sophomore level materials science course and laboratory for mechanical engineers. Responsibilities included preparing and giving lectures, homework and tests.

**Teaching Assistant, Aerodynamics** 96

Aerospace and Mechanical Engineering Dept., Australian Defence Force Academy  
 Taught sophomore engineering drawing class. Developed and graded homework and design problems for second year aerodynamics design class.

**Research Assistant, Composites** 94-97

Mechanical Engineering Dept., Brigham Young University  
 Developed new modeling tools for analyzing and predicting passive damping in composite structures utilizing a new damping technology. Developed manufacturing methods of novel passively damped composite structures. Tested and designed composite damping structures utilizing this new technology.

**Research Assistant, Tolerance Analysis** 90-94

Mechanical Engineering Dept., Brigham Young University  
 Programmed, developed, tested, debugged and marketed AutoCATS, a Computer-Aided Tolerance Modeling System. Wrote users manual and presented software to sponsoring/buying companies.

**EDUCATION**

**Mechanical Engineering, Ph. D.**

SCHOOL	Brigham Young University, Provo, Utah	94-97
DISSERTATION	Modeling of Stress Coupled Passively Damped Composite Structures in Axial & Flexural Vibration <sup>®</sup>	
GPA	4.0 / 4.0	

**Mechanical Engineering, M. S.**

SCHOOL	Brigham Young University, Provo, Utah	93-94
THESIS	A Comprehensive System for Modeling Variation in Mechanical Assemblies	
GPA	4.0 / 4.0	

**Mechanical Engineering, B. S.**

SCHOOL	Brigham Young University, Provo, Utah	90-92
GPA	3.88 / 4.0, Magna Cum Laude	
SCHOOL	Idaho State University, Pocatello, Idaho	88-90
GPA	3.94 / 4.0	

**PROFESSIONAL DEVELOPMENT**

**Appointments**

External Advisory Board, ME Department, Brigham Young University	04
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**Organizing Committee**

SPIE International Symposium on Nondestructive Evaluation	05, 06
SAMPE Material Exposition	03, 04
Northwest Fiber Optic Society Workshop	03
Australian International Aerospace Congress	01

### **Session Chair**

Congress on Corrosion in the Military Cost Reduction Strategies	05
AEROMAT Conference	04
Workshop on Structural Health Monitoring	03
Fifth Joint DOD/FAA/NASA Conference on Aging Aircraft	02
SPIE International Symposium on Nondestructive Evaluation	00
Techniques for Aging Infrastructure & Manufacturing Conference	00

### **Short Courses Taught**

Reconstruction of Trailer Side Underride Analysis	02
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### **Short Courses Taken**

Mentoring Techniques	05
Object Oriented C++ Programming for Non-C Programmers	03
Reconstruction of Trailer Side Underride Analysis	01
Behavior Description Interview Training	99
Hazardous Material on the Job Training	99
Structural Integrity of New and Aging Metallic Aircraft	99
Computer Based Modeling for Design Analysis with MSC/NASTRAN	99
Hands on Fiber Optics Sensor Course	98
Computer Based Modeling for Design Analysis with MSC/PATRAN	97
Fatigue, Fracture Mechanics & Damage Tolerance	97

### **AWARDS & HONORS**

Boeing High Potential Team	04
Boeing Pre Management Assessment Program	04
Boeing Achievement Award, 7E7 CAS	03
Employee Appreciation Award, 7E7 Nacelle	03
Boeing Future Leaders Program	03
Employee Appreciation Award, Boeing Sonic Cruiser	02
Employee Appreciation Award, MRB & Liaison	01
Employee Appreciation Award, Phantom Works	01
Boeing Cash Award, Phantom Works	01
ASM Outstanding Technical Presentation	00
Employee Appreciation Award, Boeing Test Facilities	00
National Science Foundation Graduate Fellowship	95-97
Brigham Young University Mechanical Engineering Outstanding Scholar	92
Boeing Undergraduate Scholarship	90-91
Big Sky Academic / Athletic Top Ten Team	89
Sigma Nu Fraternity Scholarship	89
Idaho State University Full Academic Scholarship	88
Society of Women Engineers Freshman Scholarship	88

### **PROFESSIONAL SOCIETIES**

WATAI	04-present
Tau Beta Pi (service committee member for 3 years)	91-present
Society of Women Engineers (publicity chairman for 3 years)	88-present
American Society of Mechanical Engineers	92-present
ASM International	00-present
Phi Kappa Phi	92-present

## SERVICE / ACTIVITIES

Jr USAV Girl's Volleyball Coach	04-05
Interlake High School Varsity Volleyball Assistant Coach	01-02
USAV Executive Board Adult Representative	99-00
USAV Women's Volleyball Coach	98-00
Varsity Volleyball (Idaho State University)	88-90
LDSSA Student Organization (service committee member)	88-90

## TECHNICAL SKILLS

Underride crash analysis  
Material failure and fracture analysis  
Subject matter expert in Structural Health Monitoring and sensor technologies for Boeing  
Basic Finite Element Analysis (static and dynamic) using PATRAN and NASTRAN  
Mechanical assembly of fiber optic components  
Quality control, design of experiments and statistical processes using MINITAB and QFD  
UNIX and DOS environment programming with FORTRAN, AutoLISP and RLAB  
Designing with CATIA, CADAM, and AutoCAD systems  
SEM and XRAY analysis including dark room experience

## PRESENTATIONS & PUBLICATIONS

### Peer Reviewed Journals

- A. Trego, et al, 2003, "A Scientific Approach to Side Underride Analysis," **Advances in Vehicle Aggressivity and Compatibility, Side and Rear Impact and Rollover Protection**, SP-1775, Society of Automotive Engineers, Warrendale, PA, SAE Technical Paper No. 2003-01-0178, pp. 41-47, 2003.
- A. Trego et al, 2001, "Axial Passive Damping Testing of Mass Produced Stress Coupled, Co-cured Damped Composites," **AIAA Journal**, Vol. 41, No. 3.
- A. Trego and D. Cope, 2001, "Evaluation of DaDT Lap Joint Analysis Tools," **AIAA Journal**, Vol. 39, No. 12, pp. 2250-2254.
- A. Trego and P. Eastman, 1999, "Flexural Damping Predictions of Mechanical Elements Designed Using Stress Coupled, Co-cured Damped Fiber Reinforced Composites," **Journal of Advanced Materials**, Vol. 31, No. 1, pp. 7- 17.
- A. Trego and P. Eastman, 1997, "Optimization of Passively Damped Composite Structures," **International Journal of Modelling & Simulation**, Vol. 17, No. 4, pp. 284-288.
- A. Trego, D. Olcott, and P. Eastman, 1997, "Improved Axial Damping of Mechanical Elements Through the Use of Multiple Layered, Stress Coupled, Co-cured Damped Fiber Reinforced Composites," **Journal of Advanced Materials**, Vol. 28, No. 2, pp. 28-34.

### Journals / Papers

- A. Trego et al, 2001, "Structural Technology and Analysis Program (STAP) Delivery Order 0004: Durability Patch," **AFRL-VA-WP-TR-2001-3037**.
- A. Trego et al, 2001, "Analysis of Side Underride Crashes Misconceptions and the Problems," **Accident Investigation Quarterly**, Issue 27, summer 2001, pp.17-19.

#### **Peer Reviewed Conferences**

- A. Trego and G. Clark, 2005, "Structural Health Monitoring System: from Collection to Analysis," **International Workshop on Structural Health Monitoring**, San Francisco, CA. September 2005.
- A. Trego, et al, 2005, "Development of a Corrosion Diagnostics and Prognostics System," **First World Congress on Corrosion in the Military Cost Reduction Strategies**, Sorrento, Italy. June 2005.
- A. Trego, 2004, "Structural Health Monitoring Technology on Commercial Aircraft II," **European Workshop on Structural Health Monitoring**, Munich, Germany. July 2004.
- C. Greenberg et al, 2004, "Structural Health Monitoring Technology on Commercial Aircraft," **Seventh International Aerospace Corrosion Control Symposium**, Amsterdam, Holland. April 2004.
- A. Trego, 2003, "Installation of the Autonomous Structural Integrity Monitoring System," **International Workshop on Structural Health Monitoring**, San Francisco, CA. September 2003.
- A. Akdeniz et al, 2003, "Structural Health Management (SHM) Technology Implementation on Commercial Airplanes," **Sixth Joint DoD/FAA/NASA Conference on Aging Aircraft Proceedings**, New Orleans, LA. September 2003.
- A. Trego, 2003, "An Update on Monitoring Moisture Ingression with Fiber Optic Sensors," **Sixth Pacific Northwest Fiber Optic Workshop**, Troutdale, Oregon. May 2003.
- A. Trego, 2003, "Monitoring Moisture Ingression with Fiber Optic Sensors," **Sixth International Conference on Sandwich Structures**, Ft. Lauderdale, Florida. March 2003.
- J. Elster, et al, 2003, "Flight Demonstration of Fiber Optic Sensors," **SPIE's International Symposium on Nondestructive Evaluation Techniques for Aging Infrastructure & Manufacturing Conference Proceedings**, Newport Beach, California. March 2003.
- A. Trego, and D. Smith, 2002, "Battery Operated Health Monitoring System," **Fifth Joint DoD/FAA/NASA Conference on Aging Aircraft Proceedings**, San Francisco, Ca. September 2002.
- D. Banaszak, et al, 2002, "Damage Dosimeter Third Octave and Time History RMS Values," **Joint Statistical Meeting 2002**, New York, NY. August 2002.
- D. Banaszak, et al, 2002, "A Quick Look at Flight Data from a Digital Damage Dosimeter," **ESTECH 2002 Environmental Sciences and Technology**, Mount Prospect, IL. May 2002.
- A. Trego, R. Keller, 2002, "Fiber Optics in Bonded Repairs," **SAMPE 2002 International Symposium & Exhibition**, Long Beach, CA. May 2002.

- E. Haugse, et al, 2001, "Structural Vibration Monitoring for Damped Repair Design," **Third International Workshop on Structural Health Monitoring**, Stanford, Ca, 2001.
- A. Trego, et al, 2001, "Optical Fiber-Based Health Monitoring Systems for Composite Structures," **AIAC Australian International Aerospace Congress**, Canberra, ACT, Australia 2001.
- J. Elster, et al, 2001, "Optical Fiber-Based Adhesive Bondline Monitoring Systems for Composite Patch Systems," **SPIE's International Symposium on Nondestructive Evaluation Techniques for Aging Infrastructure & Manufacturing Conference Proceedings**, Newport Beach California. March 2001.
- J. Elster, M. Jones, P. Tuloa, A. Trego, and I. Perez, 2000, "Corrosion Monitoring in Aging Aircraft Using Optical Fiber-Based Chemical Sensors," **Fourth Joint DoD/FAA/NASA Conference on Aging Aircraft Proceedings**, St. Louis, Missouri, pp. 13-20.
- W. Schulz, E. Udd, J. Seim, I. Perez, and A. Trego, 2000, "Progress on Health Monitoring of An Adhesive Joint Using a Multi-Axis Fiber Grating Strain Sensor System," **SPIE's International Symposium on Nondestructive Evaluation Techniques for Aging Infrastructure & Manufacturing Conference Proceedings**, Vol. 3991-9, Newport Beach California.
- E. Udd, et al, 2000, "Use of Transversely Loaded Fiber Grating Strain Sensors for Aerospace Applications," **SPIE's International Symposium on Nondestructive Evaluation Techniques for Aging Infrastructure & Manufacturing Conference Proceedings**, Vol. 3994-17, Newport Beach California.
- E. Udd, et al, 2000, "Multidimensional Strain Field Measurements Using Fiber Optic Grating Sensors," **SPIE's International Symposium on Nondestructive Evaluation Techniques for Aging Infrastructure & Manufacturing Conference Proceedings**, Vol. 3986-35, Newport Beach California.
- W. Schulz, E. Udd, M. Morrell, J. Seim, I. Perez, and A. Trego, 1999, "Health Monitoring of an Adhesive Joint Using a Multi-Axis Fiber Grating Strain Sensor System," **SPIE's International Symposium on Nondestructive Evaluation Techniques for Aging Infrastructure & Manufacturing Conference Proceedings**, Vol. 3586, Newport Beach California, pp. 41-52.
- A. Berens, D. West and A. Trego, 1999, "Risk Assessment of Fatigue Cracks in Corroded Lap Joints," **RTO Applied Vehicle Technology Panel Meeting Proceedings 18: Fatigue in the Presence of Corrosion**, Cedex, France, pp. 21-1 – 21-10.
- D. Cope, A. Trego, and D. West, 1999, "Analytical Framework for Assessment of Corrosion and Fatigue in Fuselage Lap Joints," **Second Joint NASA/FAA/DoD Conference on Aging Aircraft Proceedings NASA/CP-1999-208982/Part1**, Williamsburg, Virginia, pp. 472 – 481.
- A. Trego, E. Haugse and E. Udd, 1998, "Material Removal Rate Fiber Optic Corrosion Sensor," **Fourth Pacific Northwest Fiber Optic Sensor Workshop Proceedings of SPIE**, Vol. 3489, Troutdale, Oregon, pp. 105-109.
- A. Trego, et al, 1998, "Analytical Methodology for Assessing Corrosion and Fatigue in Fuselage Lap Joints," **1998 Air Force Corrosion Program Conference Proceedings**, Macon, Georgia.

A. Trego, P. Eastman, W. Pratt, and C. Jensen, 1995, "Reduced Boring Bar Vibrations Using Damped Composite Structures," **Proceedings of the 1995 Design Engineering Technical Conferences**, Vol. 3, Part A, pp. 305-311.

A. Trego, P. Eastman, and C. Jensen, 1995, "Optimization of Passively Damped Composite Structures," **Proceedings of the IASTED International Conference on Applied Modelling, Simulation and Optimization**, pp. 137-141.

### **Presentations**

A. Trego, 2004, "Structural Health Management: An Overview of Current Research Efforts at Boeing," **ASM Aeromat Conference**, Seattle, Washington.

K. Cooper, et al, 2004, "Fiber Optic Sensor System for Aircraft Health Monitoring," **ASM Aeromat Conference**, Seattle, Washington.

A. Trego, 2004, "Autonomous Structural Integrity Monitoring System for Environmental Conditions," **CPAC Conference**, Seattle, Washington. Invited Presentation.

A. Trego, 2004, "Autonomous Structural Integrity Monitoring System for Environmental Conditions," **CHTE Conference**, Seattle, Washington.

A. Trego, 2003, "Autonomous Structural Integrity Monitoring System," **DASCON Conference**, Seattle, Washington.

R. Ikegami, A. Trego, 2002, "Battery Operated Health Monitoring System," **DASCON Conference**, St. Louis, Missouri.

R. Ikegami, E. Haugse, and A. Trego, 2001, "Structural Monitoring for Damped Composite Repairs," **ASM Aeromat Conference**, Long Beach, California.

A. Trego and T. Leeks, 2000, "Damage Detection Techniques Through The Use Of Acoustic Emissions," **ASM Aeromat Conference**, Seattle, Washington. **Outstanding Technical Presentation Award.**

R. Ikegami and A. Trego, 2000, "Structural Health Management: An Overview of Current Research Efforts at Boeing," **ASM Aeromat Conference**, Seattle, Washington.

E. Udd, W. Schulz, J. Seim, I. Perez, A. Trego, E. Haugse, 2000, "Nondestructive Evaluation of Adhesive Joints Using Advanced Fiber Grating Strain Sensor Technology," **ASM Aeromat Conference**, Seattle, Washington.

A. Trego, 2000, "The Use of Fiber Optic Sensors for Health Monitoring of Bonded Repair Structures," **Fifth Pacific Northwest Fiber Sensor Workshop**, Troutdale, Oregon.

E. Udd, W. Schulz, M. Morrell, J. Seim, I. Perez, A. Trego, 1999, "Structural Health Monitoring of an Adhesive Joint Using a Multi-Axis Fiber Grating Strain Sensor System," **ASM Aeromat Conference**, Dayton, Ohio.

A. Trego, and K. Chase, 1993, "AutoCATS User's Manual," **Association for the Development of Computer Aided Tolerancing Systems (ADCATS)**, Brigham Young University, Provo, Utah.

A. Trego, 1995, "Improved Structural Damping of Mechanical Elements Through the Use of Multiple Layered, Stress Coupled, Co-cured Damped Fiber Reinforced Composites,"

**SAMPE '95 International SAMPE Symposium & Exhibition, Anaheim, California.  
First place: SAMPE National Student Competition for Ph. D. Division.**

A. Trego, 1993, "Tolerance Analysis," **SAMPE '95 International SAMPE Symposium & Exhibition, Anaheim, California. First place: SAMPE National Student Competition for M. S. Division.**