Diagnostics & Prognostics for Engineered Systems

Radically new requirements in safety and performance for mechanical and electrical products are transforming the way we engineer them. For example, manufacturers of gas turbine engines for airplanes now sell ‘time on wing’ to airlines instead of engines. In this new ‘pay as you go’ business environment, manufacturers pay the costs for servicing and fixing engines instead of the airlines. If engine health is poorly managed, the manufacturer’s profits can plummet. A somewhat similar scenario is unfolding for buildings. Companies are now offering complete facility management and maintenance leading to reduced cost-to-benefit ratios for implementing diagnostics. Automotive manufacturers of cars and trucks are also leasing vehicles rather than selling them. These manufacturers are searching for new ways to effectively manage vehicle health in order to reduce warranty costs and increase aftermarket profits.

Federal agencies are also implementing sweeping changes in product requirements. For example, emissions standards for engines, durability standards for tires, readiness requirements for weapon systems, security requirements for terrestrial power and transportation systems, energy standards for buildings and associated equipment, and reliability requirements for exploratory space systems are all being addressed by government officials.

These trends in consumer, commercial, and defense applications make it critically important for manufacturers to embed technologies inside of their products to help manage them. Diagnostic devices are embedded into products to identify how they are used, develop faults, and fail. Prognostic methods are then used to predict and manage the health of these products. Sensors and embedded processors and algorithms for monitoring products are the building blocks of diagnostics & prognostics.

The advantages of diagnosis & prognosis in a wide range of mechanical, electrical and other products have been demonstrated by researchers at the Herrick Labs in consumer, commercial, and defense applications.

Dr. Doug Adams  
Dr. James Braun
<table>
<thead>
<tr>
<th>NAME</th>
<th>YEAR</th>
<th>DEGREE</th>
<th>PROFESSOR(S)</th>
<th>TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abram, Kwin R.</td>
<td>1994</td>
<td>MSME</td>
<td>Bernhard, R.J.</td>
<td>Indirect Measurement of Internal Engine Forces</td>
</tr>
<tr>
<td>Bahr, Ronald A.</td>
<td>1970</td>
<td>MSME</td>
<td>Soedel, W.</td>
<td>Residual Stresses in a Pressure-Displacement Converter Diaphragm Due to Boundary Contraction and Localized Plastic Deformation</td>
</tr>
<tr>
<td>Bell, Ian</td>
<td>2011</td>
<td>Ph.D.</td>
<td>Braun, J.E./Groll, E.</td>
<td>Theoretical and Experimental Analysis of Liquid Flooded Compression in Scroll Compressors</td>
</tr>
<tr>
<td>Berther, Thomas</td>
<td>1990</td>
<td>MSME</td>
<td>Davies, P.</td>
<td>Condition Monitoring of Check Valves in Reciprocating Pumps</td>
</tr>
<tr>
<td>Brackney, Larry J.</td>
<td>1994</td>
<td>Ph.D.</td>
<td>Shoureshi, R.</td>
<td>Automated Reasoning Techniques for Intelligent Control of Building Systems</td>
</tr>
<tr>
<td>Breuker, Mark</td>
<td>1997</td>
<td>MSME</td>
<td>Braun, J.E.</td>
<td>Evaluation of a Statistical, Rule-Based Fault Detection and Diagnostics Method For Vapor Compression Air Conditioners</td>
</tr>
<tr>
<td>Buehler, Patarick J.</td>
<td>2002</td>
<td>MSME</td>
<td>Franchek, M.A.</td>
<td>Fault Detection, Isolation and Identification Via Information Synthesis</td>
</tr>
<tr>
<td>Chen, Bin</td>
<td>2000</td>
<td>MSME</td>
<td>Braun, J.E.</td>
<td>Evaluating the Potential of On-Line Fault Detection and Diagnostics for Rooftop Air Conditioner</td>
</tr>
<tr>
<td>Chen, Xi</td>
<td>2007</td>
<td>MSME</td>
<td>Chen, Y.</td>
<td>A Numerical Study on Decontaminating Unoccupied Airliner Cabins</td>
</tr>
<tr>
<td>NAME</td>
<td>YEAR</td>
<td>DEGREE</td>
<td>PROFESSOR(S)</td>
<td>TITLE</td>
</tr>
<tr>
<td>---------------------</td>
<td>------</td>
<td>--------</td>
<td>--------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Cummins, Josh</td>
<td>2010</td>
<td>MSME</td>
<td>Adams, D.E.</td>
<td>Center of Gravity Effects Using Forced Vibration Response Operational Data</td>
</tr>
<tr>
<td>Deignan, Paul B. HL99-9</td>
<td>1999</td>
<td>MSME</td>
<td>Meckl, P.</td>
<td>Virtual Sensing: The Development of a Methodology for Internal Combustion Engine Torque Estimation</td>
</tr>
<tr>
<td>DiPetta, Tiffany</td>
<td>2011</td>
<td>MSME</td>
<td>Adams, D.E.</td>
<td>Development and Verification of a Diagnostic Cleat for Detecting Faults in Military Wheeled Vehicles</td>
</tr>
<tr>
<td>Faulkner, Lynn L. HL 66-33</td>
<td>1966</td>
<td>MSME</td>
<td>Hamilton, J.F.</td>
<td>Stress Concentration in Refrigeration Compressor Crankshafts</td>
</tr>
<tr>
<td>Gayaka, Shreekant</td>
<td>2010</td>
<td>Ph.D.</td>
<td>Yao, B.</td>
<td>An Adaptive Robust Approach to Actuator Fault-Tolerant Control in Presence of Uncertainties and Input Constraints</td>
</tr>
<tr>
<td>Geveci, Mert HL 2005-8</td>
<td>2005</td>
<td>Ph.D.</td>
<td>Bernhard, R.J.</td>
<td>Robust Cylinder Health Monitoring for Internal Combustion Engines</td>
</tr>
<tr>
<td>Gluck, Rafael HL 63-8</td>
<td>1963</td>
<td>Ph.D.</td>
<td>Cohen, R.</td>
<td>Fatigue Life Index Criteria for Compressor Leaf Valve Design (Development of Fatigue Life Index as a Criterion for Evaluating Compressor Leaf Design)</td>
</tr>
<tr>
<td>Gupta, Jitendra</td>
<td>2010</td>
<td>Ph.D.</td>
<td>Chen, Y.</td>
<td>Respiratory Exhalation/Inhalation Models and Prediction of Airborne Infection Risk in an Aircraft Cabin</td>
</tr>
<tr>
<td>Houtteman, Matthew</td>
<td>2011</td>
<td>MSME</td>
<td>Adams, D.E.</td>
<td>Applications of Eigenmode Coupling to</td>
</tr>
<tr>
<td>NAME</td>
<td>YEAR</td>
<td>DEGREE</td>
<td>PROFESSOR(S)</td>
<td>TITLE</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------</td>
<td>--------</td>
<td>-----------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Hundhausen, R. Jason</td>
<td>2004</td>
<td>MSME</td>
<td>Adams, D.E.</td>
<td>Damage Detection in Beams</td>
</tr>
<tr>
<td>HL 2004-8</td>
<td></td>
<td></td>
<td></td>
<td>Mechanical Loads Identification and Diagnosis for a Standoff Metallic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Thermal Protection System Panel in a Semi-Realistic Thermo-Acoustic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Operating Environment</td>
</tr>
<tr>
<td>Jankov, Dusan</td>
<td>1985</td>
<td>MSME</td>
<td>Soedel, W.</td>
<td>Valve Failure Detection in Refrigeration Compressors</td>
</tr>
<tr>
<td>HL 85-17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HL 2006-13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jankov, Dusan</td>
<td>1985</td>
<td>MSME</td>
<td>Soedel, W.</td>
<td>Valve Failure Detection in Refrigeration Compressors</td>
</tr>
<tr>
<td>HL 85-17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>James, Scott</td>
<td>2007</td>
<td>MSME</td>
<td>Meckl, P.</td>
<td>Diesel Engine Diagnostics Using Singular Spectrum Analysis</td>
</tr>
<tr>
<td>HL 2007-11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Johnson, Timothy J.</td>
<td>2006</td>
<td>Ph.D.</td>
<td>Adams, D.E.</td>
<td>Diagnostics of Bead Area Damage in Rolling Tire Durability Tests</td>
</tr>
<tr>
<td>HL 2006-21P</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joshi, Alok A.</td>
<td>2007</td>
<td>Ph.D.</td>
<td>Meckl, P./King, G./Jennings, K.</td>
<td>Strategies for Data-Based Diesel Engine Fault Diagnostics</td>
</tr>
<tr>
<td>HL 2007-13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HL 2011-3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kim, Jong Shik</td>
<td>1986</td>
<td>Ph.D.</td>
<td>Soedel, W.</td>
<td>Three Dimensional Transient Stress Wave Propagation in a Plate with Application to Compressor Valve Failure Analysis</td>
</tr>
<tr>
<td>HL 86-4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kim, Woohyun</td>
<td>2009</td>
<td>MSME</td>
<td>Braun, J.E.</td>
<td>Evaluation of a Virtual Refrigerant Charge Sensor</td>
</tr>
<tr>
<td>HL 2009-12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kostek, Theodore M.</td>
<td>2005</td>
<td>Ph.D.</td>
<td>Franchek, M.</td>
<td>Aging of Zeolite Based Automotive Hydrocarbon Traps with Applications to Diagnostics</td>
</tr>
<tr>
<td>HL 2005-3P</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NAME</td>
<td>YEAR</td>
<td>DEGREE</td>
<td>PROFESSOR(S)</td>
<td>TITLE</td>
</tr>
<tr>
<td>--------------------</td>
<td>------</td>
<td>--------</td>
<td>--------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Li, Haorong</td>
<td>2004</td>
<td>Ph.D.</td>
<td>Braun, J.E.</td>
<td>A Decoupling-Based Unified Fault Detection and Diagnosis Approach for Packaged Air Conditioners</td>
</tr>
<tr>
<td>Liu, Yangfan</td>
<td>2011</td>
<td>MSME</td>
<td>Bolton, J.S./Davies, P.</td>
<td>Sound Field Reconstruction and its Application in Loudspeaker Sound Radiation Prediction</td>
</tr>
<tr>
<td>Marshall, Andrew</td>
<td>2012</td>
<td>Ph.D.</td>
<td>Davies, P.</td>
<td>Development of a Model of Startle Resulting from Exposure to Sonic Booms</td>
</tr>
<tr>
<td>Martin, Brett G.</td>
<td>2003</td>
<td>MSME</td>
<td>Meckl, P.</td>
<td>The Use of Information Theory in Input Space Selection for Modeling and Diagnostic Applications</td>
</tr>
<tr>
<td>McGuire, Sarah</td>
<td>2012</td>
<td>Ph.D.</td>
<td>Davies, P.</td>
<td>Modeling Aircraft Noise Induced Sleep Disturbance</td>
</tr>
<tr>
<td>McKellar, Michael G.</td>
<td>1987</td>
<td>MSME</td>
<td>Tree, D.R.</td>
<td>Failure Diagnosis for a Household Refrigerator</td>
</tr>
<tr>
<td>McKay, Shawn</td>
<td>2009</td>
<td>Ph.D.</td>
<td>Adams, D.E.</td>
<td>A Control Theory Based Hybrid Architecture to Anticipate and Shape Adversarial Behavior</td>
</tr>
<tr>
<td>More, Ranjit</td>
<td>2011</td>
<td>MSME</td>
<td>Meckl, P.</td>
<td>Diagnostics of Advanced Diesel Fuel Injectors</td>
</tr>
<tr>
<td>More, Shashikant</td>
<td>2010</td>
<td>Ph.D.</td>
<td>Davies, P.</td>
<td>Aircraft Noise Characteristics and Metrics</td>
</tr>
<tr>
<td>Oh, Hilario L.</td>
<td>1963</td>
<td>MSME</td>
<td>Cohen, R.</td>
<td>Dynamic Strains on a High Speed Compressor Discharge Valve</td>
</tr>
<tr>
<td>Pidaparti, Ramana M.V.</td>
<td>1989</td>
<td>Ph.D.</td>
<td>Yang, H.T./Soedel, W.</td>
<td>Modeling and Fracture Prediction in Rubber Composites</td>
</tr>
<tr>
<td>Pranati, Surve</td>
<td>2008</td>
<td>MSECE</td>
<td>Meckl, P.</td>
<td>Diesel Particulate Filter Diagnostics Using Correlation and Spectral Analysis</td>
</tr>
<tr>
<td>NAME</td>
<td>YEAR</td>
<td>DEGREE</td>
<td>PROFESSOR(S)</td>
<td>TITLE</td>
</tr>
<tr>
<td>-----------------------</td>
<td>------</td>
<td>--------</td>
<td>--------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Prewett, Emily</td>
<td>2008</td>
<td>MSME</td>
<td>Adams, D.E.</td>
<td>Modeling and Identification of Damage in Composite Materials</td>
</tr>
<tr>
<td>Ro, Hee Seung HL 89-36</td>
<td>1989</td>
<td>Ph.D.</td>
<td>Soedel, W.</td>
<td>Modeling and Interpretation of Fatigue Failure Initiation in Rubber Related to Pneumatic Tires</td>
</tr>
<tr>
<td>Robinson, Daniel H.</td>
<td>2007</td>
<td>MSME</td>
<td>Bernhard, R.J.</td>
<td>Effect of Low Frequency Sound on Resonant Sound Insulation and Rattle Systems</td>
</tr>
<tr>
<td>Sasidharan, Premjee HL 2008-1</td>
<td>2008</td>
<td>MSME</td>
<td>Meckl, P.</td>
<td>Development of an Electronic Fuel Injection System for a Small Electric Power Unit</td>
</tr>
<tr>
<td>Schultz, Ryan E. HL 2010-10P</td>
<td>2010</td>
<td>MSME</td>
<td>Meckl, P.</td>
<td>Light-Off Temperature Shift as a Detection Method of Catalyzed Diesel Particulate Filter Nonmethane Hydrocarbon Oxidation Efficiency Degradation</td>
</tr>
<tr>
<td>Shah, Chintan HL 2008-9</td>
<td>2008</td>
<td>MSME</td>
<td>Meckl, P.</td>
<td>Particulate Matter Load Estimation in Diesel Particulate Filters</td>
</tr>
<tr>
<td>Silverstein, Brian R.</td>
<td>1995</td>
<td>Ph.D.</td>
<td>Davies, P.</td>
<td>Monitoring of Valve Condition in Reciprocating Pumps by Analysis of Vibration Signatures</td>
</tr>
<tr>
<td>Stallard, Laura HL 89-25</td>
<td>1989</td>
<td>MSME</td>
<td>Shoureshi, R.</td>
<td>Model Based Expert Systems for Failure Detection and Identification of Household Refrigerators</td>
</tr>
<tr>
<td>Surve, Pranati HL 2008-5</td>
<td>2008</td>
<td>MSECE</td>
<td>Meckl, P.</td>
<td>Diesel Particulate Filter Diagnostics Using Correlation and Spectral Analysis</td>
</tr>
<tr>
<td>Wagner, John R.</td>
<td>1989</td>
<td>Ph.D.</td>
<td>Shoureshi, R.</td>
<td>Nonlinear Observer Design and Failure</td>
</tr>
<tr>
<td>NAME</td>
<td>YEAR</td>
<td>DEGREE</td>
<td>PROFESSOR(S)</td>
<td>TITLE</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>--------</td>
<td>--------------</td>
<td>-------</td>
</tr>
<tr>
<td>HL 89-11</td>
<td></td>
<td></td>
<td></td>
<td>Diagnostics for Thermofluid Systems</td>
</tr>
<tr>
<td>Wang, Miao</td>
<td>2011</td>
<td>Ph.D.</td>
<td>Chen, Y.</td>
<td>Modeling Airflow and Contaminant Transport in Enclosed Environments with Advanced Models</td>
</tr>
<tr>
<td>White, Jonathan HL 2006-7P</td>
<td>2006</td>
<td>MSME</td>
<td>Adams, D.E.</td>
<td>Impact and Thermal Damage Identification in Metallic Honeycomb Thermal Protection System Panels Using Active Distributed Sensing with the Method of Virtual Forces</td>
</tr>
<tr>
<td>White, Jonathan</td>
<td>2010</td>
<td>Ph.D.</td>
<td>Adams, D.E.</td>
<td>Operational Monitoring of Horizontal Axis Wind Turbines with Inertial Measurements</td>
</tr>
<tr>
<td>Xue, Guangqing</td>
<td>2011</td>
<td>MSME</td>
<td>Chen, Y.</td>
<td>Design Tool for Under-Floor Air Distribution System</td>
</tr>
<tr>
<td>Zhang, Tengfei</td>
<td>2007</td>
<td>Ph.D.</td>
<td>Chen, Y.</td>
<td>Detection and Mitigation of Contaminant Transport in Commercial Aircraft Cabins</td>
</tr>
<tr>
<td>Zhang, Zhao</td>
<td>2007</td>
<td>Ph.D.</td>
<td>Chen, Y.</td>
<td>Modeling of Airflow and Contaminant Transport in Enclosed Environments</td>
</tr>
<tr>
<td>Zuo, Wangda</td>
<td>2010</td>
<td>Ph.D.</td>
<td>Chen, Y.</td>
<td>Advanced Simulations of Air Distributions in Buildings</td>
</tr>
</tbody>
</table>

Except for some of the latest theses which have restricted distribution, PhD theses may be ordered from the following:
ProQuest Dissertations & Theses (PQDT): http://www.proquest.com/products_pq/descriptions/pqdt.shtml;
Purdue University Libraries: http://www.lib.purdue.edu/access/ill/td