

INDEX

- A photoconductor, 30
Absolute humidity sensors, 29
Absolute humidity, 26, 28, 29
Accuracy, 33, 39, 54, 56, 60, 62, 64, 87, 122, 129, 131
Acquisition decision making, 114
Active mode, idle mode and sleep mode, 35
Aging, 4, 13, 23, 109, 127, 131
AI model based, 129
Analog-to-digital (A/D) converters, 32
ARINC, 169
Auburn University, 279
Autonomic logistics, 86
Availability, 1, 7, 17, 32, 38, 85, 99, 114, 119, 125, 120
Avoidance of failures, 93
BAE Systems, 171
Bar coding, 37
Base station, 36
Battery powered sensor systems, 34
Battery-free power, 44
Battery-free sensor systems, 44
Baum-Welch algorithm, 51, 63
Bayes's theorem, 61
Bayesian, 11, 19, 51, 58, 65
Biological, 25, 29, 37, 59
Biosensors, 29
Bit error failures, 122
Body heat, 44
Boeing 2, 87, 109
Boeing, 173
Built-in prognostics, 121
Built-in test (BIT), 3
Business case, 47, 85, 88, 93, 104, 108, 106, 110, 116, 134
CALCE, 2, 7, 14, 73, 80, 100, 115, 130
Canaries and Fuses, 121
Canary devices, 7, 73, 76, 98, 123
Capacitive or inductive impedances, 28
Capacitive RH sensors, 28
Capacitive voltage sensors, 27
Cellular, 37
Chemical sensing principles, 29
Chemical Sensors, 29
Chemical, 11, 13, 25, 38, 74, 79
Chi square test, 49, 54
China, 255
Classification, 30, 49, 52, 66, 69, 74, 120
Classifier, 50, 52, 56
Clustering, 17, 54, 63, 72, 139
COCOMO, 90
Code Architecture, 132
Code Maintenance, 132
Commercially available, 38, 40
Common considerations, 33
Component Level, 120, 124, 129
Conditional probability, 50, 56, 59
Condition-based maintenance plus (CBM+), 4
Conductive filament formation, 81, 125
Conductive path formation, 124
Continuous distributions, 54
Continuous sampling, 36
Continuous sensing, 35
Continuous, triggered, thresholds, 35
Conventional numeric, 129
Corrosion, 2, 9, 79, 117, 124, 126
Cost avoidance, 85, 93
Cost benefit analyses (CBAs), 109
Cost benefit, 86, 109, 115, 131
Cost, 3, 17, 32, 38, 63, 82
Cost, ROI, Business Case Development, 131
Counterfeit parts, 125
Counterfeit, 121, 125
Counterfeit/tamper detection, 121
Coupled waveguide sensors, 31
Cramer-Rao Lower Bound, 52
Cross-functional, 131
Cumulative distribution functions (CDFs), 54
Current-to-voltage, 27
Damage propagation models, 129
-
- Prognostics and Health Management of Electronics.*
By Michael G. Pecht
Copyright © 2008 John Wiley & Sons, Inc.

- Data compression, 36, 41
- Data fits, 48
- Data processing, 15, 34, 40
- Data security, 37
- Data storage capacity, 41
- Data Transmission, 17, 32, 40
- Data-driven techniques, 122, 126, 129
- Data-driven, 18, 47, 82, 122
- Decision Tree Classifier, 58, 71
- Decision trees, 129
- Degrees of freedom, 55
- Dell, 120, 130
- Department of Defense (DoD), 87
- Department of Defense Small Business Innovation Research Program (SBIR), 120
- Depot Replaceable Units (DRUs), 89
- Device, 44, 73, 76, 84, 89, 98, 119.
- Dielectric breakdown, 8, 79, 124
- DIMM, 127
- Discount factor, 109
- Discount rate, 88, 109
- Discrete Event Simulation, 95, 99, 105, 108, 112, 117
- Discriminative approach, 56, 63
- Displacements, 28
- Distributed sensor networks (DSNs), 45
- Distribution, 2, 8, 12, 26, 48, 59, 62, 78, 88, 94, 122
- Distribution-free techniques, 54
- DTrace, 137
- Dual-core processors, 122
- Dynamic reconfiguration, 120, 124, 131
- Ease of implementation, 37
- Eased design and qualification of future systems, 94
- Economics, 85, 90
- EEPROM, 35
- Electrical attribute, 34
- Electrical power, 7, 27
- Electrical Sensors, 27
- Electrical, 2, 7, 22, 25, 44, 52, 60, 69, 75, 79, 126
- Electrochemical biosensors, 29
- Electrochemical sensors, 30
- Electromagnetic induction, 44
- Electromagnetic, 13, 31, 44
- Electromechanical-optical systems, 120
- Electromigration, 18, 76, 79, 124
- Electronics Industries Alliances (EIA), 122
- Electronics/electro-optical prognostics for tactical sensor system, 121, 123
- Electrostatic, 8, 27, 44, 79
- Embedded algorithms, 19, 35
- Embedded computations, 36
- Embedded processing, 36
- Embedding computational power, 36
- EmbedSense™ Wireless Sensor, 149
- Emerging Trends, 25, 44
- Emerson, 186
- EMS 200 Environmental Monitoring Sensor, 161
- Energy harvesting technology, 44
- Engine Control Unit (ECU), 86
- Environmental and operational monitoring, 120, 126
- Environmental/operational, 128
- Environmentally tolerant, 126, 128
- ePrognostics Sensor Tag, 135
- Error covariance matrix, 52
- Ethernet, 37
- Euclidean distance, 53
- European Aeronautic Defence and Space Company, 182
- Evanescent, 29, 31
- EWB MicroTAU, 139
- Expectation Maximization, 49, 51
- Expert Microsystems, 187
- Expert system, 129
- External AC power source, 34
- Failure cause, 73, 76
- Failure mechanisms, 2, 6, 14, 22, 73, 95, 110, 122
- Failure mode, 2, 6, 13, 18, 73, 94, 99, 121, 129
- Failure models, 73, 95, 99, 130
- Failure Modes, Effects, and Criticality Analysis (FMECA), 75, 86
- Failure modes, mechanisms and effects analysis (FMMEA), 6, 18, 33, 74, 81, 127
- Failure precursor, 4, 7, 122
- False alarms, 3, 11, 132
- False negative, 50
- False positive, 50, 59, 98
- Fault recognition, 36
- Feature extraction, 16, 19, 36, 48, 73
- Federal Aviation Administration, 110

- Fiber Bragg gratings, 31
- Fiber optic cable, 31
- Financial Costs, 88, 94
- Finite state machines, 129
- Fisher information matrix, 52
- Fixed schedule maintenance interval, 89, 96, 102, 114
- Flash memory, 35, 41
- Frequency counter, 27
- Frequency, 2, 9, 25, 37, 45, 54, 79, 87, 109, 122
- Functional Attributes of Sensor Systems, 34
- Fuses and Canaries, 7, 19
- Fuzzy C-means Classifier, 65
- Galvanomagnetic effect, 31
- Gate oxide breakdown, 122
- Gaussian kernel, 53
- General Dynamics, 189
- General Electric, 191
- General Motors, 120, 130
- General Motors, 195
- Generative approach, 56, 65
- Georgia Institute of Technology, 281
- G-Link Wireless, 147
- Global policies, 125
- GMA Industries, 197
- Good-as-new repair, 96
- Goodness-of-fit hypothesis test, 54
- Goodness-of-fit, 49, 54
- Grating sensors, 31
- Hall effect sensor, 27, 31
- Hall effect voltage sensors, 27
- Health monitoring (HM), 1, 11, 16, 24, 48, 63, 81, 89, 96, 106, 114, 124, 131
- Hidden Markov Model, 51, 58, 61
- Hierarchical Classifier, 58, 65
- High Mobility Multipurpose Wheeled Vehicles (HMMWV), 94, 101
- High-power switching electronics, 120
- HMM-Based Approach, 58, 64
- Honeywell, 199
- Hot-carrier degradation, 122
- Human motion, 44
- Humidity Sensors, 28
- Humidity, 2, 8, 13, 25, 33, 37, 77, 80
- Hypothesis test, 50, 54, 59
- IC devices, 120
- ICIM® 20/20, 157
- Idle state, 35
- IEEE-Aerospace, 122
- IEEE-Reliability, 122
- Impact Technologies, 202
- Imperfect monitoring, 95
- Implanted medical, 44
- Implementation Costs, 87, 94, 99, 109, 112
- Independent Component Analysis, 58, 63
- Inductive voltage sensors, 27
- Infrastructure Costs, 91, 100, 112
- Inhospitable and toxic environments, 36
- Integrated data Environment (IDE), 87
- Intelligent Automation, Inc, 206
- Interconnection, 11, 80, 121, 128
- Interconnects, 18, 74, 120, 124
- Interconnects, 18, 74, 120, 124
- Investment cost, 112
- IPC, 122
- Joint Strike Fighter (JSF), 86, 120
- JTAG, 12C and CAN buses, 123
- K Nearest Neighbor Classifier, 58, 66
- Kalman Filters, 129
- Kernel trick, 60
- kNN, 52, 55, 66
- Knowledge tool sets, 128
- Kolmogorov-Smirnov Test, 49, 54
- Legacy systems, 4, 9, 82, 120, 126, 131
- Liability and litigation, 132
- Liability issues, 12, 121, 125, 132
- Liability, 131
- Life consumption monitoring (LCM), 5, 14, 89, 95
- Life cycle, 1, 25, 33, 73, 111, 127
- Life usage assessment, 128
- Life-cycle environmental profile (LCEP), 76, 78
- Life-cycle profile, 2, 13, 79
- Life-safety, 133
- Light Armored Vehicle (LAV), 87
- Likelihood Ratio Test, 49
- Line replaceable units (LRU), 17, 74, 88, 120, 126
- Linear Discriminant Analysis, 57
- Linear Regression, 129
- Linearity, 33, 39, 66
- Lockheed Martin Aeronautics Company, 208
- Logistics footprint reduction, 93, 125
- Logistics, 1, 4, 19, 86, 90, 120, 125, 128, 132

- Log-likelihood function, 51
- Lower technologies, 122
- LRU dependent fuses, 89, 96
- LRU-independent fuses, 89, 98
- LRU-independent methodologies, 89
- LRU level, 99, 120, 126
- LRU-Independent Methods, 97, 103
- LRU-independent modeling, 98
- LRU-independent models, 99
- Machine learning, 47, 55, 58, 129, 133
- Magnetic coupling, 44
- Magnetic Sensors, 31
- Magnetic, 25, 31, 44, 64, 74
- Magnetodiodes, 31
- Magnetometers, 31
- Magneto-optic effect, 31
- Magnetoresistance, 31
- Magnetostrictive effect, 31
- Magnetotransistor sensors, 31
- Mahalanobis distance, 53
- Maintenance costs, 36, 87, 109, 119
- Maintenance Culture, 91
- Maintenance planning, 93, 112, 117
- Maintenance, 3, 14, 36, 73, 82, 85, 125
- Maintenance, repair, and overhaul operations (MROs), 110
- Mass sensor, 30
- Mathematical model, 50
- Maximum A Posteriori Estimation, 51
- Maximum Likelihood Estimation, 49
- Maximum likelihood, 49, 59
- Measurands, 25, 31
- Measurement range, 33, 39
- Mechanical Sensors, 28
- Mechanical, 12, 25, 38, 44, 74, 79, 119
- Memories, 122
- Memory management, 34, 39
- Memory, 15, 19, 32, 122, 126
- MEMS sensing devices, 124
- MEMS sensor, 44
- Micro-bend sensors, 31
- Microcontrollers, 37, 122
- Microprocessors, 19, 34, 121
- MicroWIS, 143
- Miniature Wireless, 159
- Miniaturization, 44
- Minimum Mean Square Error Estimation, 49, 51
- Minuteman III Strategic missile fleet, 114
- MITE WISTM, 141
- Mitigation of Reliability Risks, 124
- Modern pacemaker, 44
- Monte Carlo analysis, 100
- Monte Carlo simulation, 17, 95
- Mounting methods, 34
- Moving fiber optic hydrophones, 31
- MSET/SPRT, 130
- Multifunction display (MFD), 109
- Multilayer perceptron, 59
- Multiple functions, 41
- Multiple parameters, 33
- Multiple sensors, 38, 45
- Multiple Sockets, 95, 104, 108
- Multiple, flexible or add-on sensor ports, 41
- Multivariate state estimation technique (MSET), 12, 50, 130
- Naïve Bayesian Classifier, 58, 61
- NASA, 4, 63, 86, 119, 129,
- National Aeronautics and Space Administration, 235
- National Defense Industrial Association (NDIA), 121, 128
- Nearest Neighbor, 49, 52, 58, 63
- NEMS, 44
- Neural Networks, 19, 54, 129
- Neyman-Pearson Criterion, 50
- Non-battery powered sensor systems, 34
- Nondetection events, 96
- Noninvasive PHM techniques, 126
- Nonparametric Statistical Method, 52
- Nonrecurring Costs, 90, 112
- Non-technical Barriers, 121, 133
- Normalized distance, 52
- Northrop Grumman, 211
- No-trouble-found/ no-fault-found (NTF/NFF), 119, 126
- NVRAM, 35, 42
- Office of Management and budget (OMB), 109
- Onboard battery, 34
- Onboard Memory and Memory Management, 34
- Onboard memory, 32, 39
- Onboard Power, 34, 41
- Onboard processing, 36
- Onboard signal processing, 35
- Operational Profile, 85, 100, 110
- Optical (Radiant), 25
- Optical biosensors, 29

- Optical interference sensors, 31
- Optical sensors, 30
- Parameters to be monitored, 9, 32
- Parametric Statistical methods, 48, 52
- Particle Filtering, 52, 58, 63, 131
- Parzen Window (or Kernel Density Estimation), 53
- Pennsylvania State University, 285
- Perfect but partial monitoring, 95
- Phase delay, 31
- PHM hybrid approaches, 122, 126
- PHM implementation, 12, 19, 25, 33, 41, 47, 86, 89, 119, 123
- PHM Roadmap, 3, 119,
- Photoemissive devices, 30
- Photovoltaic devices, 30
- Physical attributes of sensor systems, 34
- Physics-based, 14, 129
- Physics-of- failure model, 130
- Physics-of-failure (PoF), 2, 17, 25, 47, 73, 79, 97, 121, 129
- Piezoelectric effect, 28
- Piezoelectric sensors, 29
- Piezoelectric, 28, 44
- Piezoelectricity, 28
- Polarization sensors, 31
- Power consumption, 8, 15, 34, 41, 44
- Power demand, 37
- Power Management, 34, 39, 121, 127
- Power management, 34, 39, 121, 127
- Power sensor, 27
- Precision, 13, 33, 39
- Precursor to Failure Monitoring, 96
- Precursor to failure, 13, 89, 96, 111
- Prediction, 1, 12, 16, 36, 40, 47, 61, 64, 69, 95, 103, 114, 120, 126, 132
- Present value, 88
- Pressure sensors, 28
- Preventative maintenance, 89, 93
- Principal Component Analysis, 19, 53, 63
- Printed circuit boards, 15, 80, 120
- Prioritize the considerations, 33
- Probability density function (PDF), 53, 65, 97, 111
- Probability theory, 47, 56
- Product maintenance, 120, 125, 132
- Prognostic distance, 8, 87, 95, 102, 111, 131
- Prognostic levels, 74
- Prognostics and health management (PHM), 2, 16, 85, 119
- Programmable Sampling Mode and Sampling Rate, 35
- Qualtech Systems, Inc, 214
- Radiation damage, 125
- Radio Frequency Identification (RFID), 19, 37, 45
- Radio frequency identification (RFID), 19, 37, 45, 125
- Radio power, 44
- Range of communication, 37
- Rao-Blackwell Estimation, 52
- Rao-Blackwell theorem, 52
- Raytheon Company, 215
- Real time failure avoidance, 93
- Reasoner engine, 128
- Recurring Costs, 87, 90, 99, 109, 112
- Reduced waste stream, 94
- Reduction in NFFs, 93
- Reduction in redundancy, 93
- Redundancy, 38, 68, 92, 124, 131
- Redundant, 114, 128, 131
- Reliability, 1, 11, 32, 38, 68, 73, 93, 100, 110, 119
- Reliable, available, and maintainable (RAM), 125
- Remaining Useful Life (RUL), 3, 13, 17, 47, 65, 73, 80, 89, 93, 125, 130
- Repair cost reduction, 93
- Repeatability, 33
- Replaceable or rechargeable batteries, 34
- Requirements for the sensor system, 32
- Resistive humidity sensors, 28
- Resolution, 11, 32, 39, 112, 129
- Resource management, 92, 126
- Response time, 33, 39
- Return on Investment (ROI), 85, 100, 111, 131
- RFID tag, 37
- RFID technology, 37, 125
- Ridgetop Group, 216
- Risk priority number (RPN), 77
- Rockwell Automation, 218
- Rogowski coil, 27
- S2NAP®, 163
- Safety margin, 95, 98
- Sampling rate, 34, 39, 42
- Sandia National Laboratories, 238
- SAVER™ 3X90, 145

- Schlumberger, 120
- Scientific Monitoring, Inc, 222
- Security of wireless data, 37
- Self-calibration, 38
- Self-diagnostics, 38
- Self-healing, 122, 126
- Self-monitoring analysis and reporting technology (SMART), 12, 22
- Semiconductor Industry Association (SIA), 122
- Sensing modes, 35
- Sensing principles, 25, 29
- Sensitivity, 17, 31, 39, 59, 63, 67, 81, 132
- Sensor fusion, 38
- Sensor System Performance, 33
- Sensor system selection, 32
- Sensor Systems, 19, 25, 32, 41, 121
- Sensor validation, 38
- Sensor's environmental and operating range, 38
- Sentient Corporation, 220
- Sequential Monte Carlo method (SMC), 65
- Sequential probability ratio test (SPRT), 12, 50, 130
- SG Link® Wireless Strain Node, 153
- Shop Replaceable Units (SRUs), 88
- Signal Processing Software, 36, 41
- Signal processing, 35
- Single-event upset, 122
- Smart sensor nodes, 45
- SmartButton, 137
- SmartSignal Corporation, 225
- Smiths Aerospace (GI), 226
- Socket, 89, 94
- Software, 3, 13, 32, 36, 40, 73, 87, 90, 120, 123, 127, 132
- Solar cells, 44
- Solder fatigue, 125
- Source Lines of Code (SLOC), 90
- Southwest Airlines, 109, 110
- Squid, 31
- SR-1 Series, 165
- SRAM components, 122
- Stabilization time, 33, 39
- Standards Organizations, 133
- State-of-the-art and the availability of the sensor systems, 39
- Statistical methods, 47, 52, 67, 70
- Statistics, 47, 51, 54, 129
- Stochastic analysis, 95, 101
- Stochastic decision model, 95
- Strain gauges, 15, 28
- Strain, 13, 15, 25, 28, 31, 42, 73, 79
- Stroboscopic effect, 27
- Structural health monitoring (SHM), 131
- Stryker Brigade Combat Team (SBCCT), 87
- Sufficient Statistic, 52
- Sun Microsystems, 12, 120, 127, 130
- Sun Microsystems, 230
- Sunlight, 44
- Supervised learning, 56, 60, 130
- Supplier, 38, 125, 132
- Supply and logistics, 125
- Supply chains, 120, 125
- Support Vector Machines, 19, 60
- Survey, 4, 38, 41, 119, 129
- SVM- Based Approach, 58, 63
- Switching power electronics, 123
- System of systems, 18, 74
- System theory, 129
- Systems-of-systems, 120
- Tag devices, 126
- TC- Link® Wireless, 155
- Test statistic, 49, 54
- Thermal conductivity humidity sensors, 28
- Thermal detectors (RTDs), 26
- Thermal gradient, 44
- Thermal voltage sensors, 27
- Thermal, 13, 25, 44, 74, 95, 123, 127
- Thermistors, 26, 29
- Thermochemical sensors, 29
- Thermocouple, 26
- Thermoelectric effects, 26, 44
- Thermoelectric generators, 44
- Fin whisker, 121, 124
- Total internal reflection sensors, 31
- Trade Space Visualizer, 87
- Training, 4, 50, 68, 82, 87, 90, 121, 124, 125
- Transduction, 25
- Transfer range and speed of an RFID tag, 37
- U.S. Air Force JSF program, 120
- U.S. Army's Future Combat Systems, 120
- Ultra low-power electronics, 44
- Ultra-low power consumption, 44

Uncertainties, 17, 88, 94, 98, 114, 130
Uncertainty, 18, 33, 39, 94, 98, 100, 105, 130
Underwater acoustic sensors, 31
United States Air Force, 239
United States Army, 241
United States Navy, 253
University of California at Los Angeles, 287
University of Maryland—CALCE, 289
University of North Carolina (UNC), 300
University of Tennessee (UT), 295
Unscheduled maintenance costs, 109
Unscheduled Maintenance, 3, 5, 82, 86, 89, 93, 98, 105
Unsupervised learning, 47, 56, 63, 131
Vanderbilt University, 302
Variance, 52, 66
Verification and validation, 121, 129
VENTEC Corporation, 234
Vibration, 2, 13, 25, 31, 50, 74, 97
Vicinity cards, 37
V-Link® Wireless Voltage Node, 151
Warning of future (but not imminent) failure, 93
Warranty methodologies, 125
Weibull, 110
Whiskers, 124
Wilcoxon Rank Sum Test, 54
Wind turbines, 44
Wind, 44
Wire chafing, 124
Wired data transmission, 37
Wireless networks, 44
Wireless sensor nodes, 36
Wireless transmission, 36, 45

