



Reliability
ALACARTE™

News

TOP EVENT: *Applied Reliability Symposium - Orlando, FL.*

Spring-Summer 2006

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Theme this newsletter:

TEST FIXTURE DESIGN & FABRICATION

IN THIS ISSUE

COURSES and SEMINARS - Both public and in-house courses

EVENTS - Workshops and Symposiums

SPECIAL OFFERS

Free Admission to Applied Reliability Symposium

NEW SERVICES -

Test Fixture Design & Fabrication

Software Reliability

Packaging Design and Testing

Field Data Analysis

Regulatory Compliance Testing and Certification

NEWS - Ops A La Carte in the news

FEATURED SERVICE - Test Fixture Design & Fabrication

NEW TOOL - Simulation Approach to Reliability Analysis

ADVERTISEMENTS - Advertise here and watch your business grow

JOB OPENINGS - Looking for a job? Check our new section here !

COURSES

▶ **Certified Reliability Engineer (CRE) Preparation Course** (pdf) - **Aug 25-Oct. 3, 2006**

To register, email us at CRECourse@opsalacarte.com

▶ For details see the [Ops A La Carte Schedule](#)

SEMINARS

▶ *The following is a list of all our public seminars for the the next few months. Most of our seminars are taught as **in-house tailored** seminars. To view a list of all our seminars, please go to the [Ops A La Carte Course List](#)*

Design for Reliability (2 days)

▶ August 3-4, 2006 Irvine, CA (with [Hobbs Engineering](#))

▶ September 18-19, 2006 ARTS Symposium EAST - New York (with [Hobbs Engineering](#))

▶ October 26-27, 2006 San Jose, CA (with [Hobbs Engineering](#))

Designing for Warranty Cost Reduction

▶ October 25, 2006 San Jose, CA (with [Hobbs Engineering](#))

▶ For details see the [Ops A La Carte Schedule](#)

OTHER SEMINARS COMING IN 2006 - inquire if interested at education@opsalacarte.com

▶ Mechanical Design for IC Packaging

▶ Design for Manufacturability (DfM)

▶ Design for Testability (DfT)

▶ Design for 6 Sigma (DfSS)

▶ Design for 'X' (DfX)

▶ Design of Experiments (DoE)

▶ HALT and HASS Application

▶ Statistics for 6 Sigma

▶ Design for Climatic Conditions

▶ Design for Vibration and Shock

▶ Software Reliability

▶ RoHS

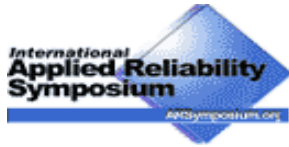
▶ Root Cause Analysis

▶ For details on these NEW seminars, see the [Ops A La Carte Course List](#)

EVENTS

▶ **Applied Reliability Symposium - June 14-16, 2006, Orlando, FL**

Our presentation will be on Lot Acceptance Testing for Complex IC's. We shall also be exhibiting at this symposium so please come by our booth. For more details, please go to <http://www.arsymposium.org>. Email us at ARS@opsalacarte.com for more information on this event.



▶ **Accelerated Stress Test Workshop - October 4-6, 2006, San Francisco, CA**

Ops A La Carte is on the local committee for this year's AST Workshop in being held at the Fisherman's Warf in San Francisco. Various OALC consultants have been invited to present their shall also be presenting several papers on various topics within reliability, including the following: 1)AST Results on RoHS Products, 2)Competitive Analysis, 3) Design for Warranty Cost Reduction, 4) HALT vs. ALT - When to Use Which Technique, and 5) Lot Acceptance Testing A Method for Reducing the Need for Failure Analysis.

We shall also be exhibiting at this symposium so please come by our booth. For more details, please go to [Accelerated Stress Testing and Reliability](#). Email us at ASTR@opsalacarte.com for more information on this event.



▶ **Beyond RoHS and WEEE:**

**Preparing for the Energy-using Products Directive and Design for Environment
A Technology Forecasters and Goodbye Chain Workshop
June 7, 2006, in San Diego, California**



▶ For details on these events, go to [Ops A La Carte Events](#)

SPECIAL OFFERS

▶ **Free Admission to the Applied Reliability Symposium** to the first individual that turns us onto a new consultant.. We are growing rapidly and are looking for the best technical operations' consultants out there. If you know of anyone, please pass their name to us at consultantsearch@opsalacarte.com.

NEWS



- May 31, 2006

Ops A La Carte releases 6th Quarterly Newsletter. The article for the quarter is [Test Equipment Design and Fabrication](#). Also included is an article by BlockSim on their modeling software.

- May 29, 2006

Ops A La Carte holds 5th Annual Consultants Party. This event is to thank all of our consultants for making us as strong as we are. We now have over 20 consultants and 30 collaborative partners and labs as part of our organization. Thanks! We couldn't do it without you.

- April 15, 2006

Ops A La Carte completes exhibiting at 4th event of the year. In the first quarter of the year, we exhibited at four Symposia, Workshops, and Trade Shows: RAMS, IRPS, ISQED, and D2M.

- April 2006

Ops A La Carte welcomes 5 more consultants to our team. Please welcome Lee Cooke, Brian Flanagan, Bob MacLevey, Chris Reynolds, and Rich Willis. Lee is our expert technical writer. Brian brings a new level of experience in the area of compliance testing to round out our [regulatory services](#). Bob is an expert in [failure analysis](#) as well as analyzing field databases for trends. He also develops custom database tools to help with this effort. Chris is our newest reliability wiz, taking on predictions, fmeas, derating analyses, thermal analyses, and HALT. And Rich is our test engineering guru with years of experience designing and fabricating custom test fixtures and test equipment. Rich's service is featured in this month's [newsletter article](#). Each consultants' profile is shown on our [Our Team's](#) webpage.

► **Presentations for the above events** are available for download on the [Resources Page](#) of our website.

► **For more information** on news, please visit our [News Page](#) or call (408) 472-3889.

FEATURED SERVICE



Test Fixture Design and Fabrication

Integrating In-Process Test with Lean Manufacturing Operations

With today's emphasis on creating 'lean' manufacturing operations, the challenges of In-Process Testing have changed dramatically. In the traditional manufacturing model which developed in the first half of the 20th century, complex products were broken into numerous sub-assemblies; these were assembled on separate line segments, sent to an 'inspector' for testing (remember the little round stamps!) and then forwarded back to stock to be pulled later for a higher level assembly. By the 90's, a different paradigm had come to the fore, based on ideas developed mainly in the Japanese auto industry. In this model, builds are not "pushed through the line from the start based on production-planning workorders. Rather, they are 'pulled' through by demand from the next higher station, starting with customer-order-driven demand at the end of the line and rippling back through the entire chain, even to outside suppliers. Intermediate stockroom transactions of sub-assemblies are essentially eliminated, replaced by very small kanbans (think bins) of buffer stock between successive workstations. Considerable effort is invested to level the work content from station to station so that the line flows uniformly, from frequent supplier deliveries at the front to steady, on-time customer delivery at the end. (Much of this system has been codified and dubbed 'Demand-Flow' by John Costanza of Jc-I-T, which conducts extensive training in lean manufacturing methods.)

So where does this leave the practice of In-Process Testing (IPT)? We have all come to support the dictum that 'Quality is Designed into a product, and into the Processes that produce it - it is not Tested-in! An inevitable corollary of this principle and the principles of lean manufacturing is that IPT is designated as a 'Non-Value-Added' activity within the manufacturing process. This at first seems like a difficult pill to swallow for those of us who have spent much of our careers in Test Engineering. However, proponents of the new manufacturing models are by no means suggesting that IPT should be eliminated - they understand that certain failure mechanisms will not be able to be completely designed out, or eliminated by personnel training and tight process control. The improved quality that results from a well-executed program of In-Process Testing continues to be recognized as an important component of the total value of the product delivered to the customer.

What must evolve, rather, is the way in which IPT is integrated into the production line. For example, traditional dedicated inspection stations, especially those closer to the end of the production line, have often acted as bottlenecks to the production flow; Work-In-Process piles up as too few test personnel try to sift through too many possible failure modes. To the extent that pure inspection/test stations are deployed on a demand-driven line, their staffing, equipment, and procedures must be adequate to support the overall TAKT time (productive work hours per day divided by maximum designed daily unit production capacity) of the line. That is not an easy task - diagnosing a faulty unit is highly variable process and it is almost impossible to accurately assign it a work-content-time. Alternatively, if the test station just identifies failing units and sets them aside for offline rework, it usually results in a major ballooning of WIP in the MRB queue... faulty sub-assemblies accumulate in a sort of limbo waiting to be serviced or scrapped.

A more useful strategy has arisen and become an integral part of demand-driven manufacturing lines, namely to push the inspection process back up the line into each of the individual workstations. Each production worker becomes a part of the QC process, not just of their own work but of specific aspects of the work of others at earlier workstations. This methodology is often realized by defining the manufacturing process for a product in a series of three-part 'Method Sheets' (in fact, many companies have adopted the practice of using released and

ECO-controlled method sheets as the principal controlling documentation for the product, in lieu of traditional assembly drawings). The first part of the method sheet defines a 'TQC' step verifying proper assembly or function from work done at a previous station; the second part contains a graphical instruction for the work content of the station; and the third part is a self-check or verification step for the employee's own work, which may involve visual inspection or a measure-and-record step, or some other type of personal quality assurance by the worker. If this system is intelligently deployed, many faulty components and assemblies will be revealed almost immediately after they are installed in the product, and corrective action can be initiated while the trail is still hot.

For this strategy to work effectively, test protocols must be stripped down to fast, simple checks that produce unambiguous results your average assembly line personnel, even if they are trained in SPC, may not possess the detective skills needed to make subjective quality assessments. The time required to perform the 'TQC' step must be short and nearly constant to ensure smooth flow on the line. On the equipment side, these requirements dictate either extremely simple inspection tools (such as Go-NoGo gages, continuity testers, optical comparators, and the like) or, where the importance of the potential failure mode and the difficulty of detecting it warrant, a more sophisticated PC or PLC-driven automatic tester or computer-vision system.

Further challenges emerge when one starts considering the inputs of suppliers. The traditional Incoming Inspection process is just another IPT step that is now considered Non-Value-Added. Current practice is to try to shift Quality Assurance responsibilities to the supplier insofar as possible, requiring him to maintain a mutually-acceptable QA system, to perform contractually-defined testing on critical parts before shipment, and to forward detailed reports on these activities on a regular basis. This sounds good when it is described in theory, but in reality, only the largest companies have the dedicated resources needed to manage supplier relationships to this degree of detail - in fact, many small companies can do little more than make the occasional 'supplier qualification' visit, perform a limited amount of 'first-article' inspection on critical parts, and initiate corrective action when a supplier's parts start causing failures on the line.

All of this leads to an important conclusion for achieving world-class quality in an age of outsourcing and lean manufacturing your need for Manufacturing Engineering expertise is not diminished when you trim down your production operation by having other companies build parts of your product. A company can ill afford to stake its reputation for quality upon the work of its suppliers unless it is performing its own due diligence understanding the variables affecting quality for each class of insourced and outsourced assembly and establishing systems for process control, in-process test, defect tracking and corrective action that are appropriate to each. Smaller companies whose resources are too limited to field the needed number of full-time ME's must find alternate ways of bringing in this expertise, particularly at the critical period when a new product is being transferred from engineering to manufacturing. For many, this will mean engaging outside consulting services.

Whether you use inside manufacturing engineering resources or contract with an outside consulting firm, there are some key requirements you should include in composing your Statement of Work for In-Process Testing:

1. During the initial planning of the manufacturing operation for a new product, consider building the production process on top of the quality process, rather than the other way around. This exercise will highlight critical quality issues at an earlier stage and will often lead to requests for Design-for-Quality and Design-for-Testability which engineering will be able to accommodate before final product release.
2. The overall plan for In-Process Testing should be tightly linked with a thorough and on-going process of Failure Mode Effects & Criticality Analysis (FMECA). There are always many more opportunities for in-line testing than can be economically pursued, so it is essential to choose the tests that will yield the greatest bang for the buck. Some of these will be able to be identified up front as a new product is transferred to manufacturing, and some will only appear later as defects start to show up on the line and in the field.
3. Testing for each identified failure mechanism should be performed at the earliest possible point in the production process where it can be isolated. Corrective action is most effective, cheapest, and least disruptive to line flow when it occurs close to the source of the problem. A protocol should be established for immediate action to correct faulty practices as they are identified at subsequent workstations.
4. Specify the simplest possible tools that will give the desired quality assurance outcome. Clearly differentiate between statistical quality issues, where the collection of data will genuinely contribute to improving the process or keeping it within established bounds, and Go-NoGo tests, which will ensure that already-good processes are being carried out correctly. Merely adding a data collection step does not in itself improve quality.
5. Create and implement a plan to cooperate with the quality assurance programs of suppliers, sharing process data and failure mechanism observations, so that in effect your QA process will become a downstream extension of your supplier's processes, as his QA process become upstream extensions of yours. In some instances, it will be advantageous for your company to provide special gauging and test equipment to your supplier to support this joint effort. Remember that the most cost-effective way of expanding your ME capability is to foster a close working relationship between your own ME staff and the suppliers' staffs.

Ops A La Carte has recently added a new Test Engineering service: in concert with FMECA, we will review product design and manufacturing plans, and identify optimal points for application of In-Process Testing. We will indicate whether such testing may be performed with available commercial test equipment or will require

custom equipment. Where appropriate, we will provide specifications and design drawings for gages and test fixturing, specifications for connectors and cables, for off-the-shelf data acquisition equipment, or, where required, designs for specialized data acquisition and functional test hardware.

► **For more information** on these services, please click on the following link: [Test Fixture Design and Fabrication](#). You can also email us at test@opsalacarte.com or call (408) 472-3889.

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"I am pleased to entrust my course in Test Engineering to Ops A La Carte. I am confident that they will present it effectively and that they will apply their own wide experience to develop them in line with changes in technology and methods"

--- Patrick O'Connor, Author of Test Engineering, Consultant
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The Simulation Approach to Reliability Analysis

By Ian Miller

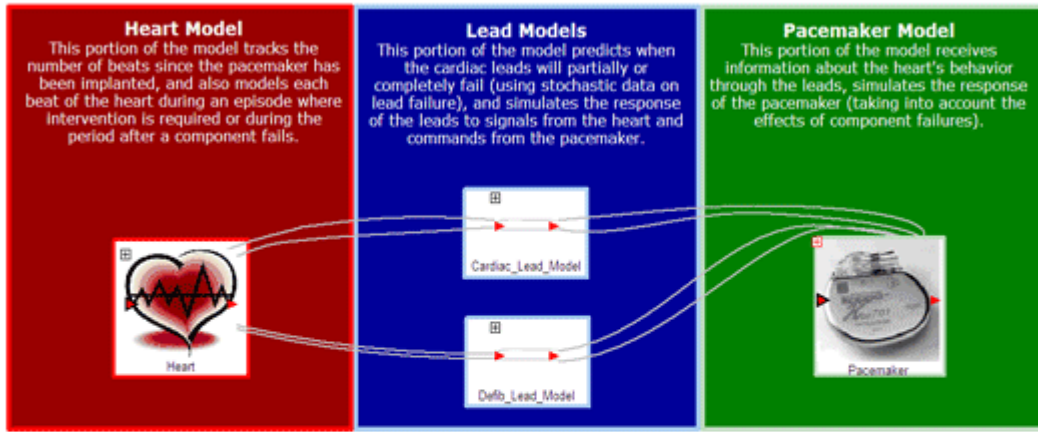
GoldSim Technology Group LLC

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Reliability engineering involves developing a model of an existing or proposed system in order to predict its in-service performance. Conventional techniques for reliability modeling often require assumptions and simplifications that may reduce the amount of information that can be obtained from a model, or may oversimplify its behavior. In addition, these techniques typically cannot address the overall performance of the system in terms of throughput, costs, or other performance measures. Our company, GoldSim Technology Group, has developed an advanced simulation approach to reliability analysis, and in this article I'll explain briefly how it works and some of the advantages of the simulation approach.

The Alternative: Dynamic Monte Carlo Simulation. Dynamic simulation allows the analyst to develop a representation of the system whose reliability is to be determined, and then observe that system's performance over a specified period of time. The software provides a sort of "language" that lets you describe the system and its components. For example, the screen-shot below is a model of a heart pacemaker system, which can be implanted within the chest of an individual who is susceptible to arrhythmia.

Pacemaker Reliability Performance Model



This is a model of an implantable cardiac pacemaker/defibrillator as described in U.S. Patent # RE37,480.

The model is run over ten years using one hundred timesteps. During portions of the simulation where the simulated heart enters tachycardia or fibrillation, the timestep is set equal to the interbeat interval, and all simulation values are recalculated at each beat.

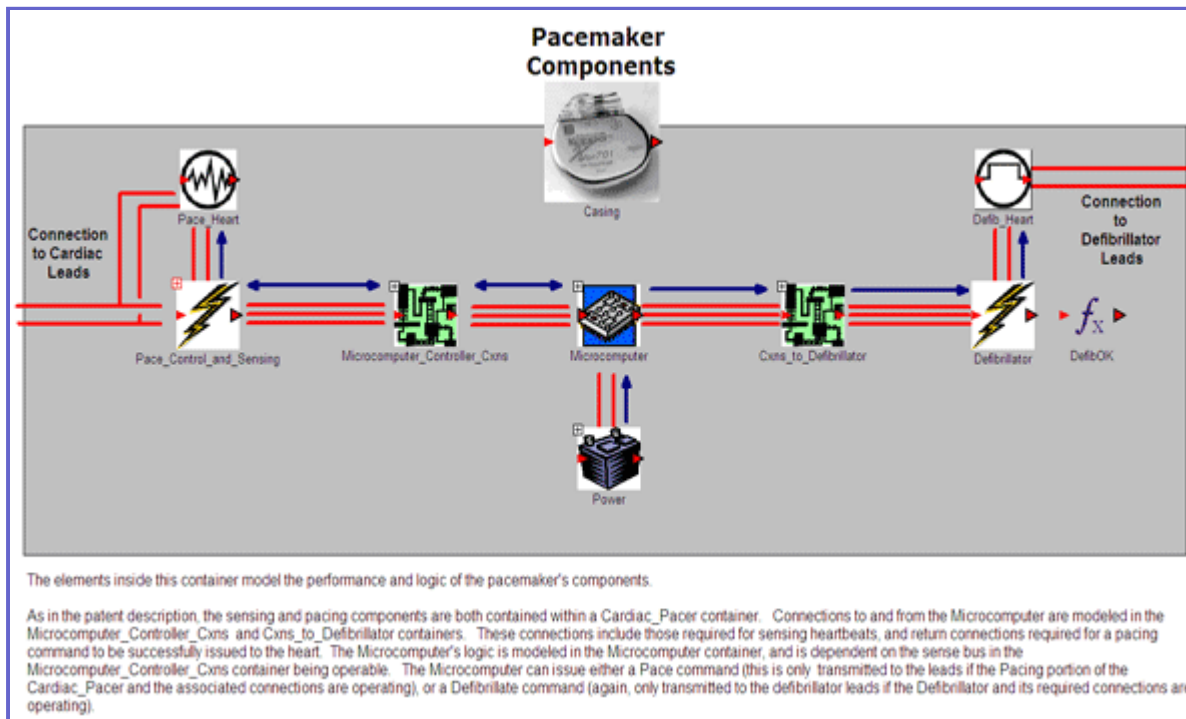
The heart container contains logic which simulates the behavior of the heart during tachycardia or fibrillation, and additional elements which track the total number of beats during the life of the device.

The two lead model containers (Cardiac_Lead_Model and Defib_Lead_Model) model the transmission of signals to the pacemaker's microcomputer as well as the transmission of pacing or defibrillation commands.

The reliability components modelling the pacemaker and the elements replicating the pacemaker's logic are all contained in the Pacemaker container.

In this case, the model includes subsystems for not only the behavior of the pacemaker (on the right), but also of the patient's heart itself (on the left), and of the leads connecting the pacemaker to the patient's heart. During a simulation, the model will track the patient's heart over a ten-year period, and each time an arrhythmia occurs it will simulate the millisecond by millisecond interactions between the heart and the pacemaker- allowing for possible failures in any component of the pacemaker system. At the same time, the model tracks the usage of the pacemaker's battery, which can run out if pacemaking shocks are required too often.

The model is quite complex internally, with the model details being contained inside the top-level components shown in Figure 1. For example, clicking on the plus-sign above the pacemaker would result in displaying the next level down into the model, similar to entering a sub-folder in a computer's file system, as shown in Figure 2. The model is structured in a very realistic way, using as many levels of organizations as desired by the user.



The elements inside this container model the performance and logic of the pacemaker's components.

As in the patent description, the sensing and pacing components are both contained within a Cardiac_Pacer container. Connections to and from the Microcomputer are modeled in the Microcomputer_Controller_Cxns and Cxns_to_Defibrillator containers. These connections include those required for sensing heartbeats, and return connections required for a pacing command to be successfully issued to the heart. The Microcomputer's logic is modeled in the Microcomputer container, and is dependent on the sense bus in the Microcomputer_Controller_Cxns container being operable. The Microcomputer can issue either a Pace command (this is only transmitted to the leads if the Pacing portion of the Cardiac_Pacer and the associated connections are operating), or a Defibrillate command (again, only transmitted to the defibrillator leads if the Defibrillator and its required connections are operating).

The primary advantages of the dynamic simulation approach are:

- The system can evolve into any feasible state and its properties can change suddenly or gradually as the simulation progresses.

- The system can be affected by random processes, which may be either internal (e.g., failure modes) or external (e.g., the onset of arrhythmia).
- If some system properties are uncertain, the significance of those uncertainties can be determined.

In Monte Carlo simulation, the model is run many times with uncertain variables sampling different values each time (each run is called a realization). These realizations are each considered equally likely, and can be combined to provide not only a mean, but also confidence bounds and a range on the performance of the system. In addition to the statistical data these realizations provide, multiple realizations may also reveal failure modes and scenarios that may not be apparent, even to experienced reliability modelers.

Figure 3 shows a result analysis for the pacemaker system, where the user is browsing through an analysis of the different failed and unfailed states that the pacemaker experienced during the simulation, investigating the different scenarios that resulted in a failure:

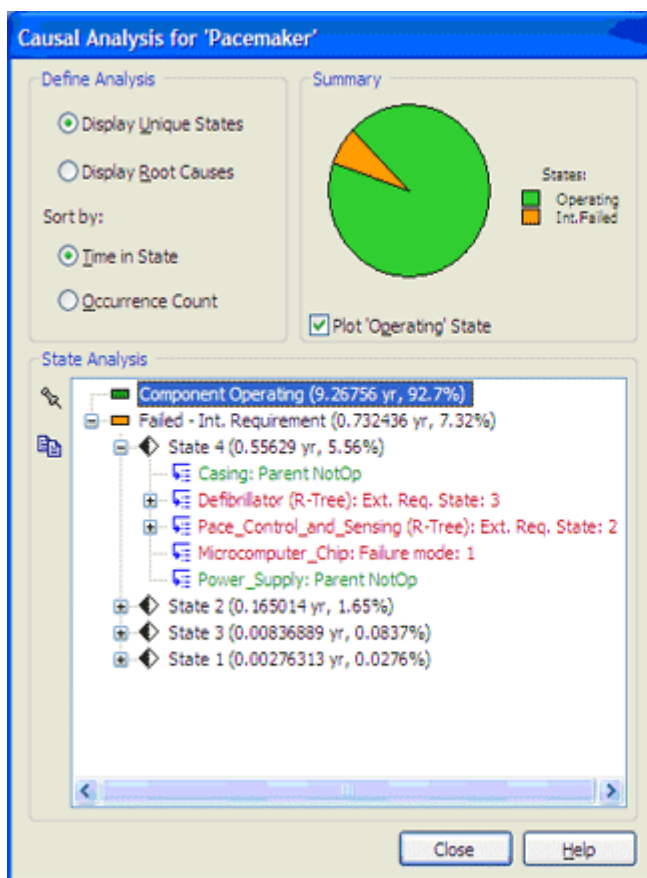
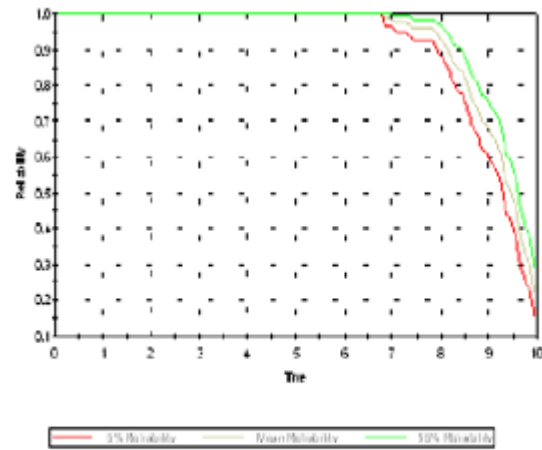
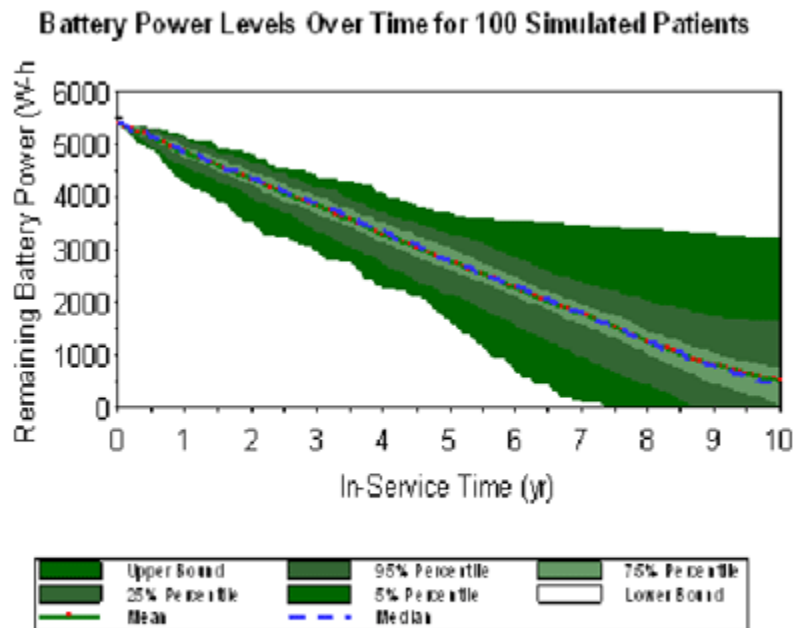


Figure 4 shows another type of response, a time-history plot showing how the pacemaker's reliability changes with time. Note that three curves are shown, indicating confidence bounds on the results of the calculations. If desired, additional Monte Carlo relaxations could be done to tighten the bounds:



Finally, Figure 5 shows another type of result, a plot showing confidence bounds versus time for the state of the pacemaker's battery:



Summary: The simulation approach exploits the power of modern personal computers to carry out more realistic analyses of complex systems. Simulation can provide valuable insights into the reliability performance of engineered systems that are difficult to model using conventional reliability approaches. Reliability engineers can incorporate all of their knowledge regarding the system into a computer model that allows them to

Predict the performance of the system

- See confidence bounds on the predictions
- Identify critical components
- Identify key failure modes

These technical results can be used to:

- Focus design and/or testing resources where they are most likely to have a positive impact
- Contrast design alternatives on the basis of warranty or maintenance costs

- Ensure that the system will meet customer and regulatory requirements for reliability.

PROBLEM SOLVER

Problem on Preventive Maintenance

Given a Weibull failure distribution for an extruder producing packaging firm with $g=400$ hours, $b=1.5$, $h=700$ hours. The cost of a scheduled preventive maintenance (PM) action is \$5,000, while the cost of an unexpected failure is \$15,000. The line operates as 8,760 hours per year and scheduled PM is now at every quarter. Determine the approximate costs for the existing PM schedule.

[Free Admission to the Applied Reliability Symposium](#) to the first individual that emails us the correct solution. You can email us at problemsolver@opsalacarte.com.

ADVERTISEMENTS



The GoldSim simulation framework allows one to probabilistically simulate the reliability and performance of complex engineered systems over time. GoldSim provides the ability to model the interdependence of components through requirements and fault trees, as well as the capability to define multiple independent failure modes for each component. This facilitates both reliability modeling and risk analysis within a variety of industries, including space and defense, manufacturing, mining, telecommunications, electronics and infrastructure. For more information, contact Tim Schmitt at tschmitt@goldsim.com or go to www.goldsim.com



Link Silicon of Valley, LLC (LinkSV) is an online networking resource for researching, identifying and contacting the companies and people within the 6,000 plus active & inactive companies in the greater Bay Area. Our company records identify the senior team, board members, financing, key partners and customers. There are many features which allow you to view the information from different angles and "connect all the dots".

LinkSV helps you tap into previously scarce and extraordinarily hard-to-find information on early stage companies and the key people associated with them. This will improve your effectiveness without the hassle and time of trying to do it all on your own. LinkSV is ideally suited to help you quickly identify and leverage your own connections in career search, in identifying new business opportunities, new investors and Board members.



The Reliability, Maintainability, and Supportability Partnership (RMS/P) organization's goal is to enhance communication, coordination and collaboration between industry and government in a manner that will encourage individuals and organizations to adopt an integrated systems engineering approach, or end-to-end management approach, when addressing RMS issues. The RMS Partnership also encourages individuals, professional societies, and industry associations to develop, use and maintain world-class RMS non-government standards. The RMS Partnership publishes a quarterly newsletter which is freely available on the Web site. Membership in the RMS Partnership is open to individuals and organizations interested in being on the cutting edge of RMS issues and initiatives both nationally and internationally.

JOB OPENINGS



Principal Engineer for Reliability and Test Development

Intuitive Surgical, based in Sunnyvale, California is the leader in the emerging field of robotic-assisted, minimally invasive surgery

Our Quality and Regulatory Affairs Division is in a growth mode, and we need to hire a Quality System/Regulatory Wizard - Back To The Future

Fast Forward One Year - Intuitive Surgical would like to thank you for doing a remarkable job of growing our Quality and Regulatory Affairs Department while keeping up with our tremendous revenue growth and demand for our robotic da Vinci Surgical System throughout the world! It was your desire to be the compliance expert and establish corporate corrective and preventative action systems, your ability to work with sophisticated computer systems and instruments such as our robotic equipment, and manage internal audit processes in accordance with company procedures for compliance with ISO which had lead to yours and our success. Everyone in the company would like to thank you for the effort and respect you showed everyone.

Back To Today - If you'd like this story to be yours, send us your resume with a half-page write up of your most significant Quality Systems accomplishment. While we are less concerned with typical job titles and said skills, we won't compromise on your ability to deliver results.

You might want to check out our Web site- www.intusurg.com - for some insight into what we are doing. We think you will be as excited as much as by where we are today, the opportunity for you to excel and be recognized for doing some of the most outstanding work of your career.

Email resumes to: Courtney.brubaker@intusurg.com or visit our web site: www.intusurg.com and click on company/careers/opportunities/clinical/regulatory affairs and quality and submit your resume on line. Intuitive Surgical 950 Kifer Road Sunnyvale, CA 94086 www.intusurg.com.



Reliability Engineer

FREESCALE SEMICONDUCTOR SEEKS RELIABILITY ENGINEER LOCATIONS: ARIZONA & TEXAS TO APPLY: Send MS Word Resume directly To - davemendoza@cox.net .

MRAM R&D is seeking Reliability Engineer with actual work experience background in physics statistical analysis, mathematics, and data analysis. R&D oriented. PhD, or MSEE ideal. Test development, mathematical model construction, data analysis, physics of failure and design of experiments. Masters Degree EE/Physics + 2 years of experience in technology development. Preferred requirements: MSEE and/or PhD

ABOUT FREESCALE SEMICONDUCTOR: Freescale Semiconductor, Inc. (NYSE:FSL, FSL.B) is a global leader in the design and manufacture of embedded semiconductors for the automotive, consumer, industrial, networking and wireless markets.

CONTACT: Dave Mendoza, Global Talent Consultant Freescale



Quality and Reliability Engineer IV

Location: Santa Clara, CA Job Specific Knowledge and Experience Knowledge for the reliability function necessary to perform job includes: understanding of the application and theory of most of the following including statistical concepts (discrete and continuous probability distributions, weibull analysis, DOE), modeling and prediction (allocation, fault tree analysis), data collection and analysis (advanced laboratory instrumentation, data acquisition and control), reliability design tools (failure modes and effects analysis), reliability testing (highly accelerated testing, environmental stress screening), product safety and liability (analysis of safety issues, risk assessment), physics of failure (failure analysis, surface and bulk analytical techniques); basic knowledge of Computer Aided Design tools; and general understanding of other engineering sciences. Thorough understanding and application of engineering principles, including electrical, mechanical, process, and vacuum; and utilization and thorough understanding the interrelationship of technologies and their effect on product reliability. Strong knowledge of project management skills. Knowledge for the Quality function includes the ability to frequently contribute to the development of new theories and methods. Employs expertise as a generalist or specialist.

If interested, call Ellen Wiegert Employment Marketing Global Staffing Programs Applied Materials, Inc. (408) 563-4627



Senior Reliability Consultants Needed !

Ops A La Carte is looking for Senior Reliability Consultants *around the world* with their own consulting practice to join our team of consultants and work on some of the most exciting and challenging projects in the industry.

CONSULTANT PROFILE

- *Set your own hours*
- *Control your own future*
- *Work on fascinating projects in new industries*
- *Travel as little/much as you'd like*
- *Be looked upon as an expert*
- *Work with the best consultants in the industry*
- *Run your own business*
- *Eligible for free seminars and symposia*
- *Freedom to work on whatever you want*

If interested, please email hr@opsalacarte.com or call (408) 472-3889.

Ops A La Carte's newsletter goes out to over 5000 subscribers. If you would like to put a job opening in next quarter's "Reliability News", email us at jobopenings@opsalacarte.com or call at (408) 472-3889.

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