Robust Design Computational System (RDCS)

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The Business Case for RDCS: Facilitate Low Cost Development

Cost Driven By Test-Fail-Fix Cycles

HISTORY

Cost

TIME

THE NEEDED FUTURE

COST

TIME

Certified Product

“Robust Design Computational System”

Certified Product

Capability Provided To:
- Fully Explore The Design Space
- Account For Variabilities
- Quantify Risks, Sensitivities, Margins, Reliabilities
Goal: Develop products insensitive to variation with an order of magnitude reduction in product development cost and cycle time.

**Automated “Business as Usual”**
- Mesh
- Analyze
- Post process
- Detail check
- Margin calculations, etc.

**Input Variables**

**Robust Design Process**

**Robust Design Results**
- Design space scans “sensitivity plots”
- Robustness “any cliffs”
- Optimization “lightest design”
- Validated codes

**Response Variables**
What is RDCS?
An Enterprise Wide Computational Tool

- An engineering code with built in strategies to perform standard deterministic design and advanced robust design methods such as: sensitivity quantification, design scanning, Taguchi signal-to-noise, deterministic optimization and probabilistic risk assessment.

- A framework for performing automated design explorations using multi-disciplinary systems models distributed over a unix computing network.

- Not just an analysis program such as finite element or discipline specific stress / thermal / fluid analysis.

- A computational system that takes care of the mundane tasks of: setting up multi-disciplinary parametric analyses, running them on a network of computers, plotting the results, etc.
Robust Design Computational System

Capture analysis & design process

Rapid parallel computing
RDCS Workflow

Robust Design Computational System: CostBeta

File  System Monitor  Help

Variables  Math Model  Design Process  Compute  Results
Definition of Global Variables & Responses

- No Repetitive or Redundant Global Variable or Response Inputs
- Same Variables & Responses are Shared by All the Design Processes
RDCS Allows Global Variables with Probabilistic Description

- Numerous Probabilistic Distribution Models Such As Normal, LogNormal, Weibull etc. are available for Characterizing The Variations

<table>
<thead>
<tr>
<th>Probabilistic Description</th>
<th>hours_flown NORMAL Distribution</th>
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<td>Variable Name: hours_flown (continuous)</td>
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<td>Source ID:</td>
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<td>Description:</td>
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Graphical Definition of Multi-disciplinary Math Model

- Customizable Service Pallet: Click and Drop Services
Design Process Selection
RDCS Design Visualization & Assessment
Applications Quantify Benefits of RDCS

1000 NONLINEAR ANSYS RUNS TO BALANCE 6 TURBINE BLADE SETS -- 200 RUNS/NIGHT

CHANGE ROCKET ENGINE HIGH PRESSURE JOINT DESIGN FOR ELV USING OVER 120 3D NON-LINEAR FEM MODEL CONFIGURATIONS

10% WEIGHT SAVINGS FOR RS-68 MANIFOLD FLANGE

Rocketdyne Propulsion & Power
Software Architecture of RDCS
State Of The Art

- Graphical User Interface
  - Ease of Use
  - Minimal Training
- Client / Server
  - Distributed Computing
  - Major Cycle Time Improvement
  - Model for Internet/Intranet Operation
- Open Architecture
  - Adding New Design Processes
  - Permits Rapid Links To Other Codes
- Object Oriented Design
  - Ease of Maintenance
  - Reusability
  - Ease of Enhancement
- C++ Motif
  - Industry Standard
  - Supports Object Oriented Design