

Optimisation Fiabiliste des systèmes mécatroniques

Prof. Abdelkhalak El hami
LOFIMS

Reliability and Uncertainties in Experimental Mechanics and Numerical

23 avril 2015, ENSA Kénitra

FOCUS

MECHANICAL ENGINEERING AND SOLID MECHANICS SERIES



Uncertainty and Optimization in Structural Mechanics

Abdelkhalak El Hami and Radi Bouchaib

ISTE

WILEY

This book includes the most recent ideas coming from the research and industry in the field of optimization, reliability and the recognition of uncertainties. The book is made up of nine chapters, reviewing uncertainty tools, system reliability and optimization (of sizing, form, topology and multi-objective) of the systems. Optimization-reliability coupling will also be tackled, in order to take into account the uncertainties in the modeling and the resolution of the problems encountered.♪

Incertitudes, optimisation et fiabilité des structures

Abdelkhalak El Hami

Bouchaïb Radi

Hermès

Lavoisier

*Résumé: La fiabilité des systèmes complexes est un défi majeur pour les entreprises industrielles. Ces dernières doivent répondre aux exigences des donneurs d'ordre dont le non-respect entraînerait des pénalités compromettant les marchés futurs. L'un des enjeux majeurs de l'optimisation fiabiliste est d'établir une surveillance rigoureuse, capable de prédire et de détecter les modes de défaillances des systèmes étudiés. Cet ouvrage présente les avancées de la recherche et de l'industrie appliquées aux domaines de l'optimisation, de la fiabilité et de la prise en compte des incertitudes en mécanique. Ce couplage est à la base de la compétitivité des entreprises dans les secteurs de l'automobile, de l'aéronautique, du génie civil ou encore de la défense. A c c o m p a g n é d ' e x e m p l e s détaillés, *Incertitudes, optimisation et fiabilité des structures* présente les nouveaux outils de conception les plus performants. Il s'adresse aux ingénieurs et aux enseignants-chercheurs.*

Seifedine Kadry - Abdelkhalak Elhami
Editors

Numerical Methods for Reliability and Safety Assessment

Multiscale and Multiphysics Systems

 Springer

LOFTMS

INSA

INSTITUT NATIONAL
DES SCIENCES
APPLIQUÉES
ROUEN

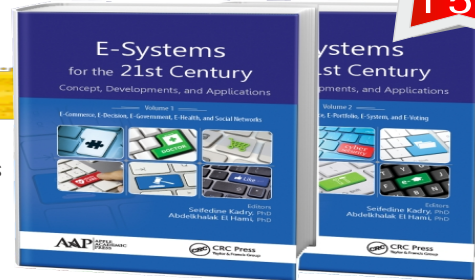


New Book Announcement

E-Systems for the 21st Century

Concept, Developments, and Applications, (Set of 2 volumes)

Forthcoming
December 2015



Volume 1: E-Commerce, E-Decision, E-Government, E-Health, and Social Networks
Volume 2: E-Learning, E-Maintenance, E-Portfolio, E-System, and E-Voting

Editors: Seifedine Kadry, PhD
Associate Professor, School of Engineering,
American University of the Middle East, Kuwait

Abdelkhalak El Hami, PhD
Professor, National Institute of Applied Sciences, Rouen, France

E-based systems and computer networks are becoming standard practice across all sectors, including health, engineering, business, education, security, and citizen interaction with local and national government. They facilitate rapid and easy dissemination of information and data to assist service providers and end-users, offering existing and newly engineered services, products, and communication channels. Recent years have witnessed rising interest in these computerized systems and procedures, which exploit different forms of electronic media in order to offer effective and sophisticated solutions to a wide range of real-world applications.

With contributions from researchers and practitioners from around the world, this two-volume book discusses and reports on new and important developments in the field of e-systems, covering a wide range of current issues in the design, engineering, and adoption of e-systems. **E-Systems for the 21st Century: Concept, Developments and Applications** focuses on the use of e-systems in many areas of sectors of contemporary life, including

- commerce and business
- learning and education
- health care
- government and law
- voting
- service businesses

The two-volume book offers comprehensive research and case studies addressing e-system use in health, business, education, security, and citizen interaction with local and national government. Several studies address the use of social networks in providing services as well as issues in maintenance and security of e-systems as well.

CONTENTS

Introduction

Volume 1: E-Commerce, E-Decision, E-Government, E-Health, and Social Networks

Preface

1. A Survey of Trust in Social Commerce
Seyyed Alireza Hashemi Golpayegani, Leila Esmaeili, Shahla Mardani, and Seyyed Muhammad Mutallebi Esfidvajani
2. e-Decision Support in Reconfigurable Manufacturing Systems
Norman Gwangwava
3. Socio-Demographic Factors and Citizens' Perception of E-Government
P. Devika and N. Mathiyalagan
4. Electronic Court Management System in Malaysia: The Legal and Functional Requirements for Court Records
Wan Satirah Wan Mohd Saman and Nurussobah Hussin
5. E-Government Formation Challenges and Solution Perspectives
Rasim Alguliyev and Farhad Yusifov
6. Technology Acceptance of E-Services in India: A Perceived Risk Perspective
Ashis Pani and Rakesh Tiwari
7. Implementation of eHealth Project in Slovenia: An International Perspective, Key Challenges, and Ways Forward
Dalibor Stanimirovic
8. Acceptance of E-Health by Healthcare Professionals in Developing Countries: Case of Morocco
Rachid Oumlil
9. eHealth for Developing Countries: A Theoretical Model Grounded on Literature
Harry Fulgencio
10. How Mediterranean Local Governments Use Facebook to Enhance Stakeholder Engagement
Alejandro Sáez-Martín, María del Mar Gálvez-Rodríguez, and María Del Carmen Caba-Pérez
11. Utilizing Social Networks for Educational Purposes
Abouzar Sadeghzadeh, Maryam Haghshenas, Mojtaba Nassiriyar, and Roghayeh Shahbazi
12. Social Networks and Information Dissemination for Disaster Risk Management
Mohammed Zuhair Al-Taie, and Siti Mariyam Shamsuddin

Volume 2: E-Learning, E-Maintenance, E-Portfolio, E-System, and E-Voting

Preface

1. Creative Criticism Writing for E-World: Design for Blended Classroom in 21st Century
Watcharapol Wiboolyasarin



9 Spinnaker Way, Waretown, NJ 08758 USA
Tel: 732-998-5302 / Fax: 866-222-9549
Email: info@appleacademicpress.com



Exclusive worldwide distribution by
CRC Press, a Taylor & Francis Group



www.appleacademicpress.com

◀ Contents continued on side 2 ▶

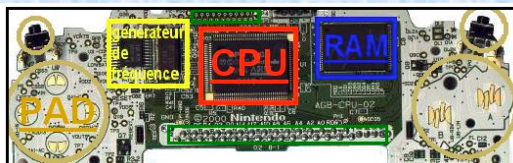
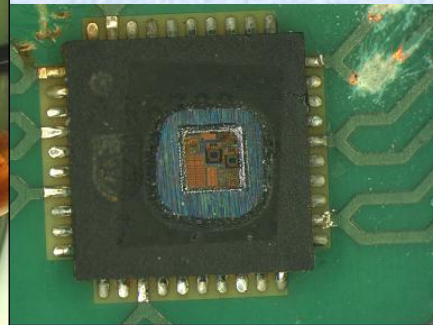
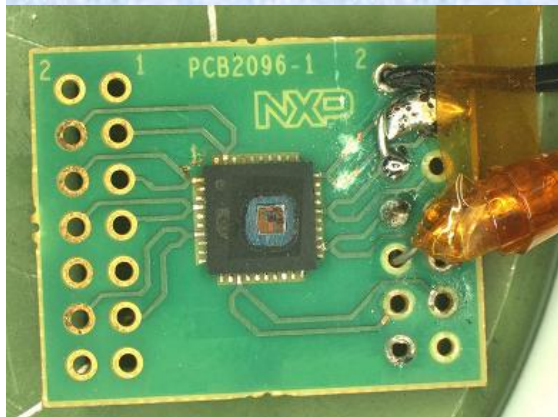
OUTLINE

- **Context**
- **Introduction**
- **Basic principles**
- **Developments**
- **New formulation :**
- **Numerical example**
- **Conclusion and Perspectives**

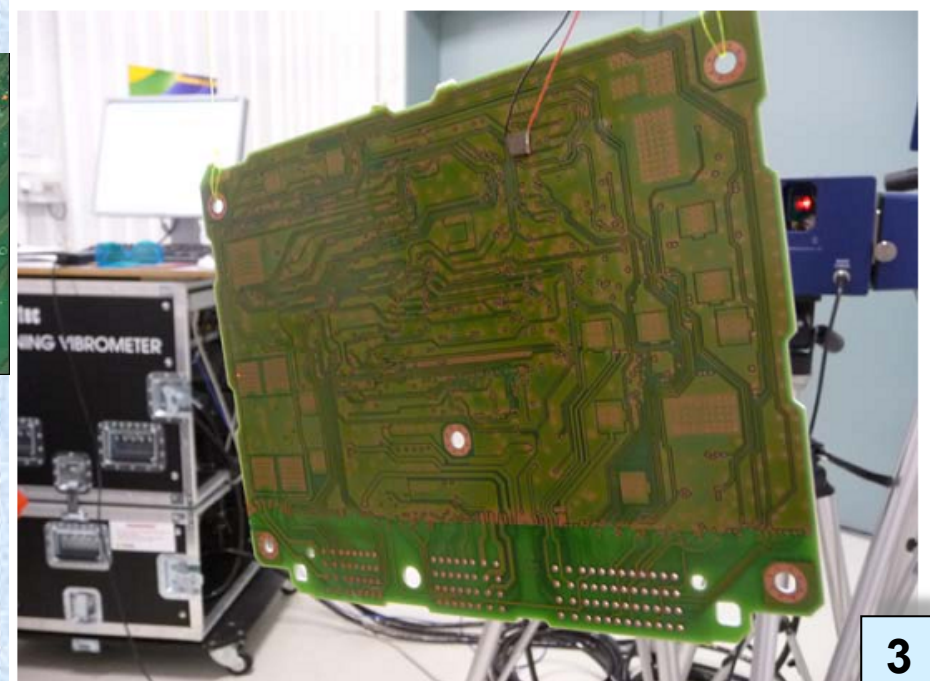
Introduction

In the embedded electronics and mechatronical system design, it is very important to minimize the structural cost and to maximize safety

Most of the critical failures are generated by the interactions between the sub systems, implemented in different technologies, e.g. mechanics, electronics, and software. Therefore the analysis of the system as a whole is not enough and it is necessary to study all the interactions in order to estimate the system reliability.



D.BORZA



volumes, leurs consommations d'énergie et leurs coûts.

Les équipements mécatroniques doivent fonctionner sans défaillance pendant des durées de service de plus en plus longues. Les conditions d'emploi particulièrement sévères de la mécatronique embarquée font apparaître des mécanismes de défaillance qui sont sources de pannes. Jusqu'à maintenant ces phénomènes de défaillance n'ont pas été abordés suffisamment en profondeur pour être maîtrisés.

Cet ouvrage présente deux méthodologies : l'approche statistique d'optimisation de la conception par la fiabilité et l'approche expérimentale pour la caractérisation de l'évolution des systèmes mécatroniques en mode de fonctionnement. Il analyse également les nouveaux outils d'analyse des effets des contraintes d'origine thermique, vibratoire, humide, électrique et électromagnétique.

Les coordonnateurs

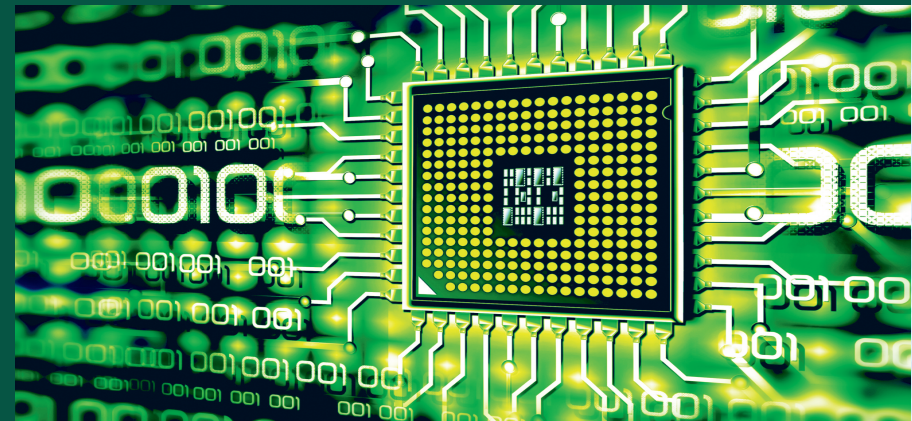
Professeur à l'INSA-Rouen, Abdelkhalak EL HAMI est responsable de la chaire de mécanique du CNAM en Normandie et de plusieurs projets pédagogiques européens.

Expert en fiabilité et en technologie produit-processus à Valeo, Philippe PUGNET est docteur-ingénieur de l'Université Scientifique et Médicale de Grenoble et ingénieur I.N.P.G. Il est responsable du management de la fiabilité de systèmes mécatroniques fabriqués en grande série.

Les systèmes mécatroniques embarqués 1

*analyse des causes de défaillances,
fiabilité et contraintes*

*sous la direction de
Abdelkhalak El Hami et Philippe Pougnet*



INSA

INSTITUT NATIONAL
DES SCIENCES
APPLIQUÉES
ROUEN

Les systèmes électroniques embarqués en réduisant leurs poids, leurs volumes, leurs consommations d'énergie et leurs coûts. Ces équipements doivent fonctionner sans défaillance pendant des durées de service de plus en plus longues.

Les systèmes mécatroniques embarqués 2 présente les avancées de la recherche et de l'industrie appliquées aux domaines des systèmes mécatroniques qui intègre la fiabilité dans le processus de conception. Accompagné d'exemples détaillés, cet ouvrage développe une méthodologie de caractérisation des défauts des systèmes mécatroniques. Il analyse la modélisation multiphysique des défauts, révélant les faiblesses de création et les mécanismes de défaillance. L'élaboration de méta-modèles permettant de simuler les effets sur la fiabilité des conditions d'emploi et de fabrication est également exposée.

Les coordonnateurs

Professeur à l'INSA-Rouen, Abdelkhalak El Hami est responsable de la chaire de mécanique du CNAM en Normandie et de plusieurs projets pédagogiques européens.

Expert en fiabilité et en technologie produit-processus à Valeo, Philippe Pognet est docteur-ingénieur de l'Université Scientifique et Médicale de Grenoble et ingénieur INPG. Il est responsable du management de la fiabilité de systèmes mécatroniques fabriqués en grande série.

ISTE
editions



ISTE
editions

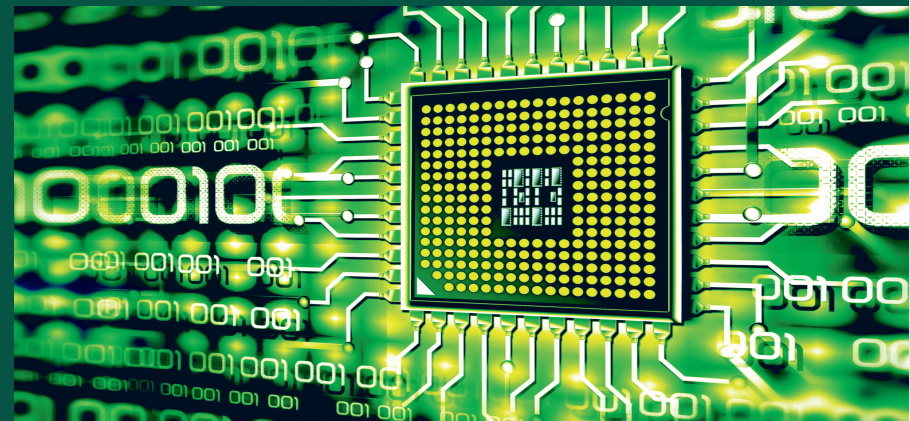
ISTE
editions

COLLECTION GÉNIE MÉCANIQUE ET MÉCANIQUE DES SOLIDES

Les systèmes mécatroniques embarqués 2

*analyse des causes de défaillances,
modélisation, simulation et optimisation*

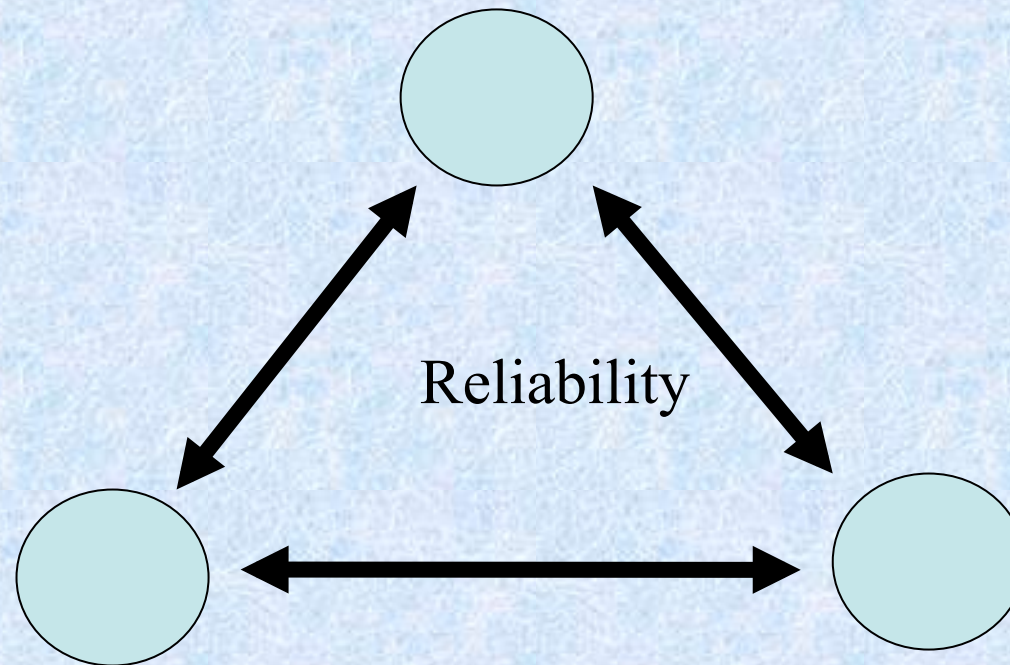
*sous la direction de
Abdelkhalak El Hami et Philippe Pognet*



sous la direction de
Abdelkhalak El Hami
Philippe Pognet

Les systèmes mécatroniques embarqués 2

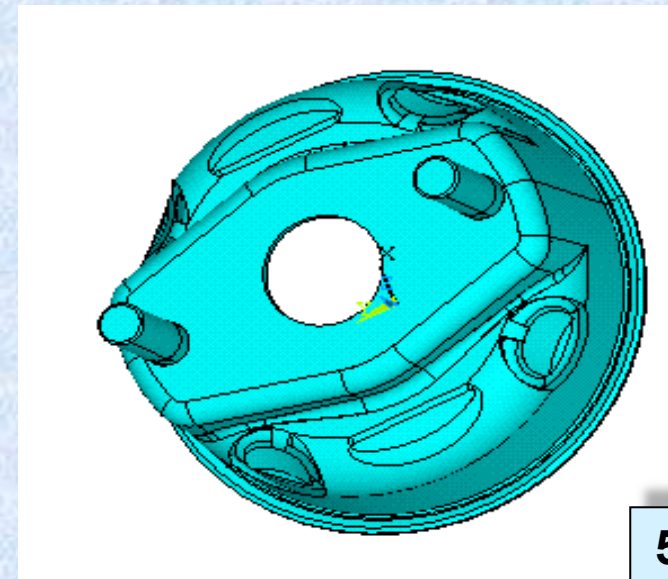
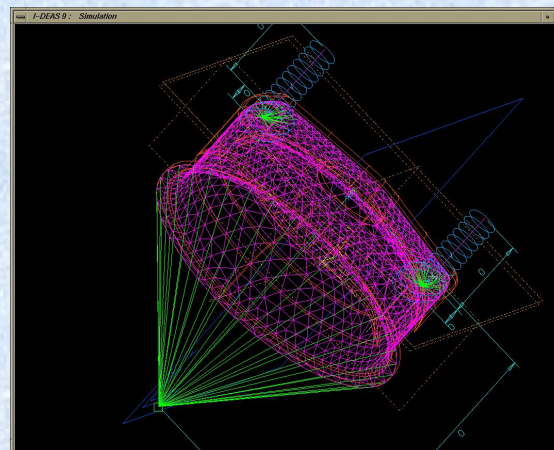
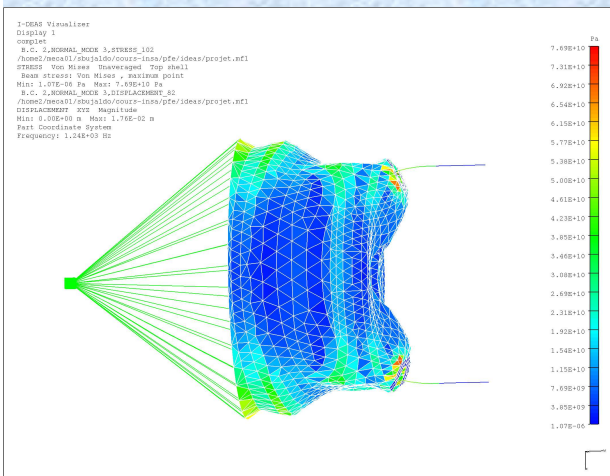
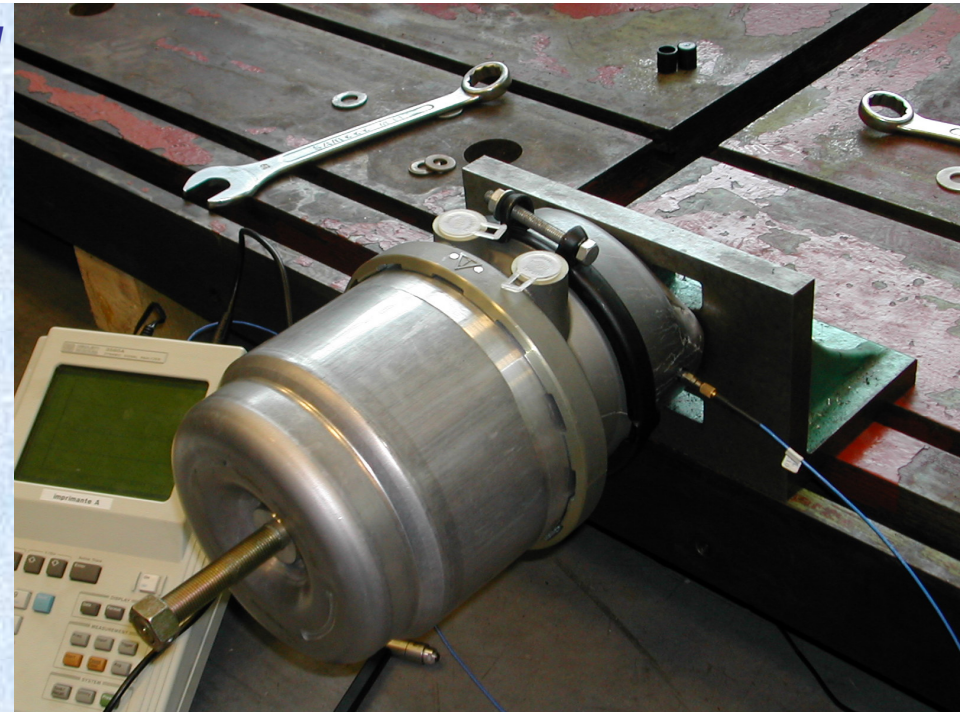
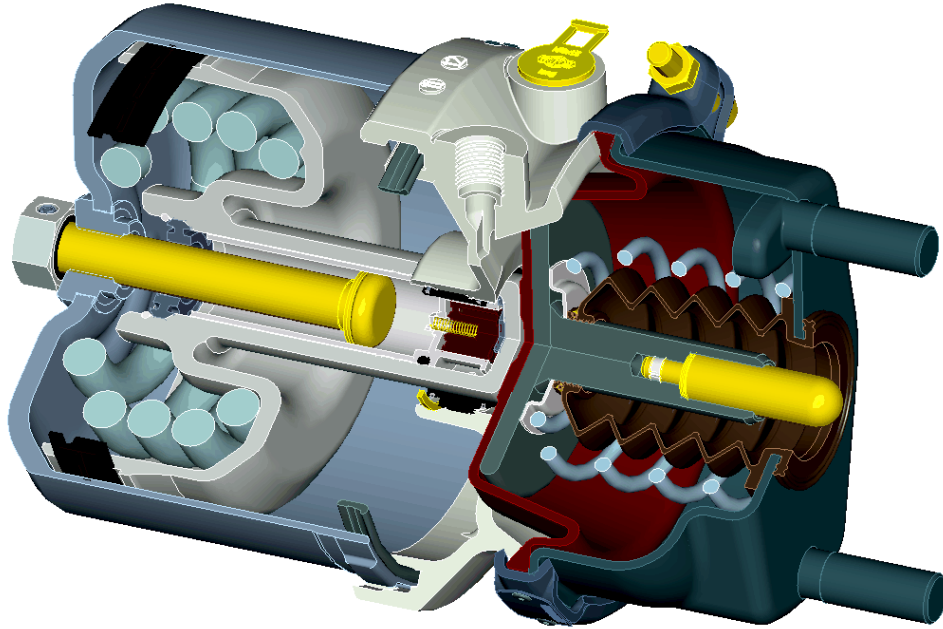
Probability Applied,
Uncertainties, Identification



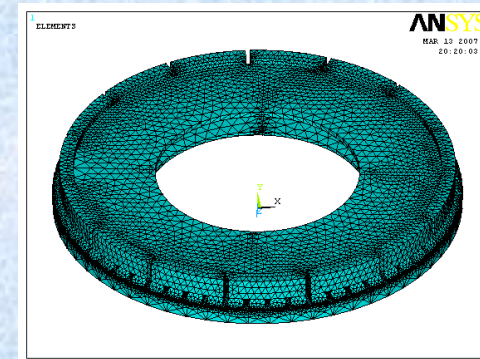
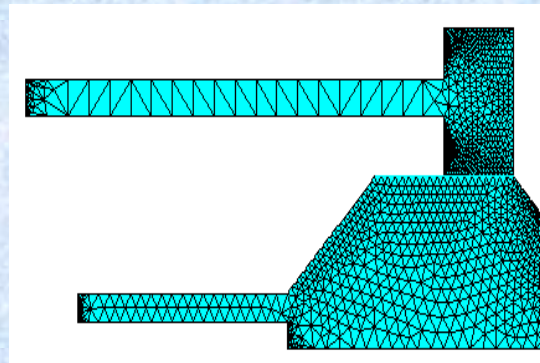
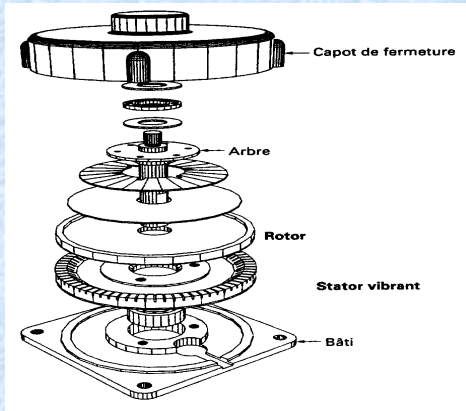
Experimental
Techniques, Optical
measurements

Modeling
Simulation,
Optimization

Optimisation on Reliability and Dynamic Response Analysis of a Spring Cylinder for Trucks Brake system



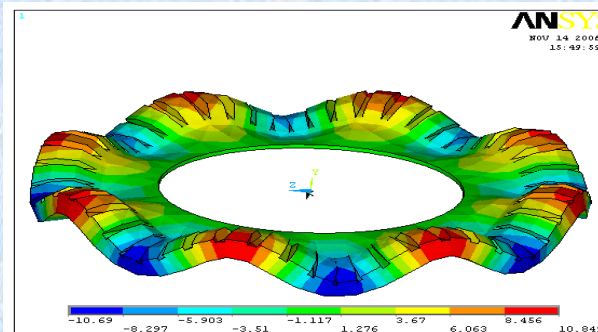
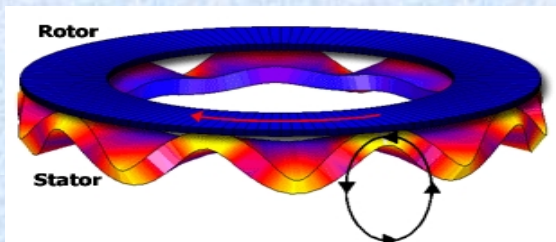
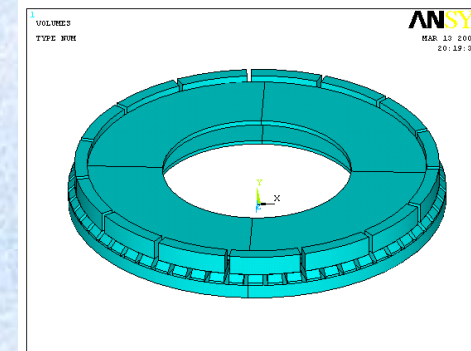
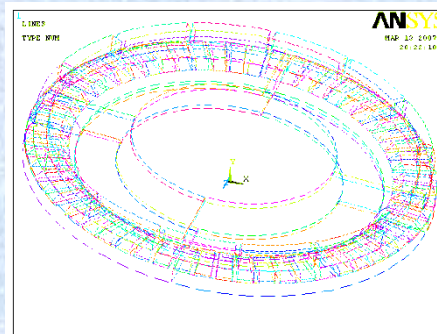
Application : Ultra sonic Actuator



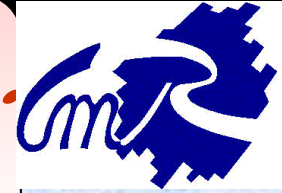
finite element of stator and rotor.



Engine USR 60



$$f_c = 39\text{KHz and } \beta_t = 3.6$$



$$\min_x f(X) \quad \text{"Cost, volume, ..."} \quad \text{♪}$$

$$\text{tel que } g_k(X) \leq 0 \quad \text{"Physics, geometrical, ..."} \quad \text{♪}$$

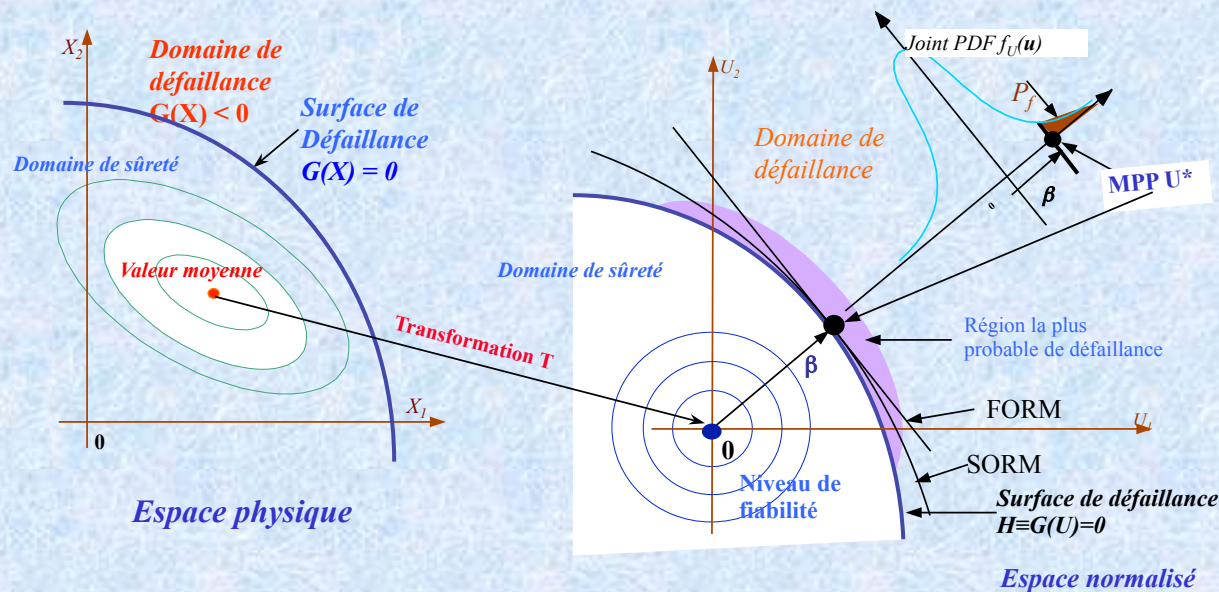
X : Design Variables ♪

Y : Random Variables ♪

u : Normalized Variables ♪

$$\beta = \min \sqrt{\sum_i T_i^2(X, Y)} = \min \sqrt{U^T U}$$

$$\text{tel que } G(X, Y) \leq 0$$



Probability of failure ♪

$$P_f = \int_{G(\{x\}, \{y\}) \leq 0} f_{\{y\}}(\{y\}) dy_1 \cdots dy_n$$



Hybrid Method

Hybrid Design Space

New form of objective function:

$$F(x,y) = f(x) \cdot \beta(x,y)$$

Limit-state to be satisfied:

$$G(x,y) = 0$$

Hybrid problem:

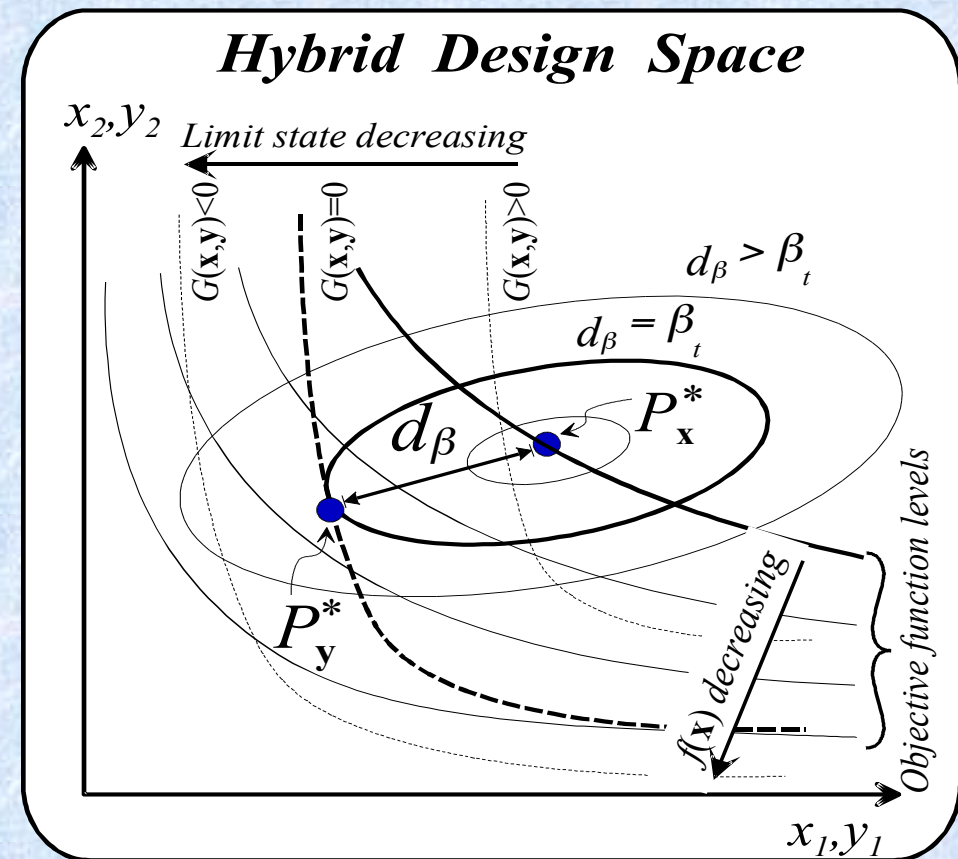
$$\min: F(x,y) = f(x) \cdot d_\beta(x,y)$$

$$\text{s.t.} : G(x,y) = 0$$

$$: g_k(x,y) \leq 0$$

$$: \beta(x,y) \geq \beta_c$$

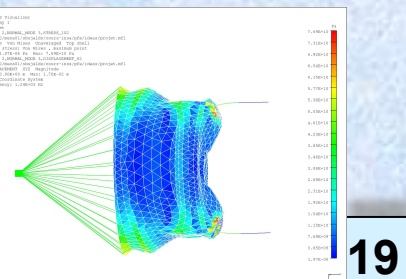
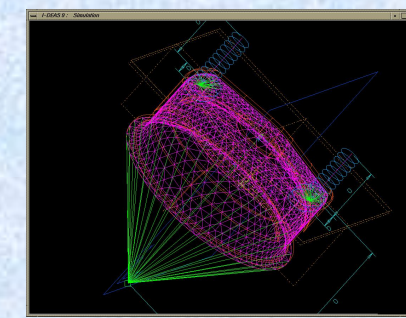
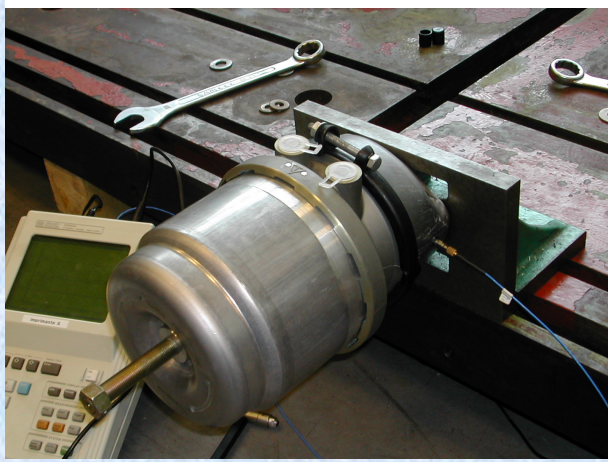
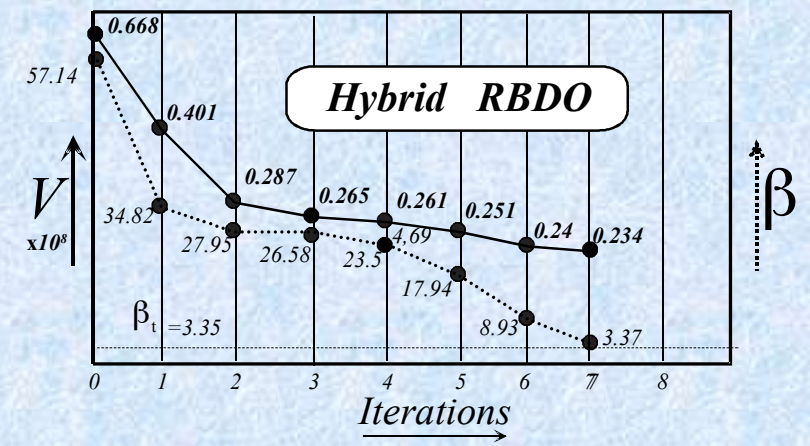
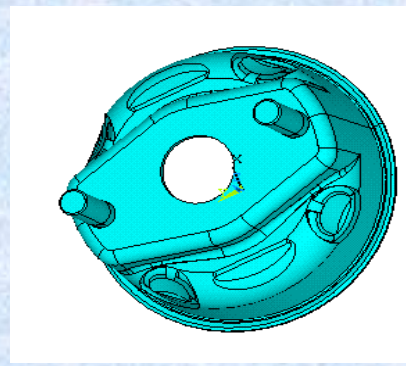
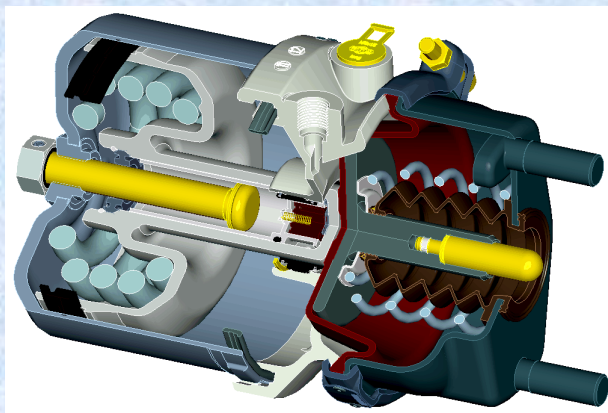
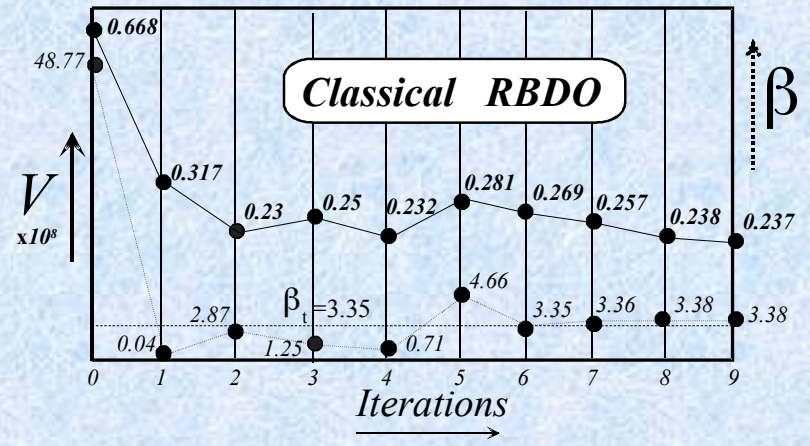
[Kharmnda EL Hami, N.Olhoff 2005]





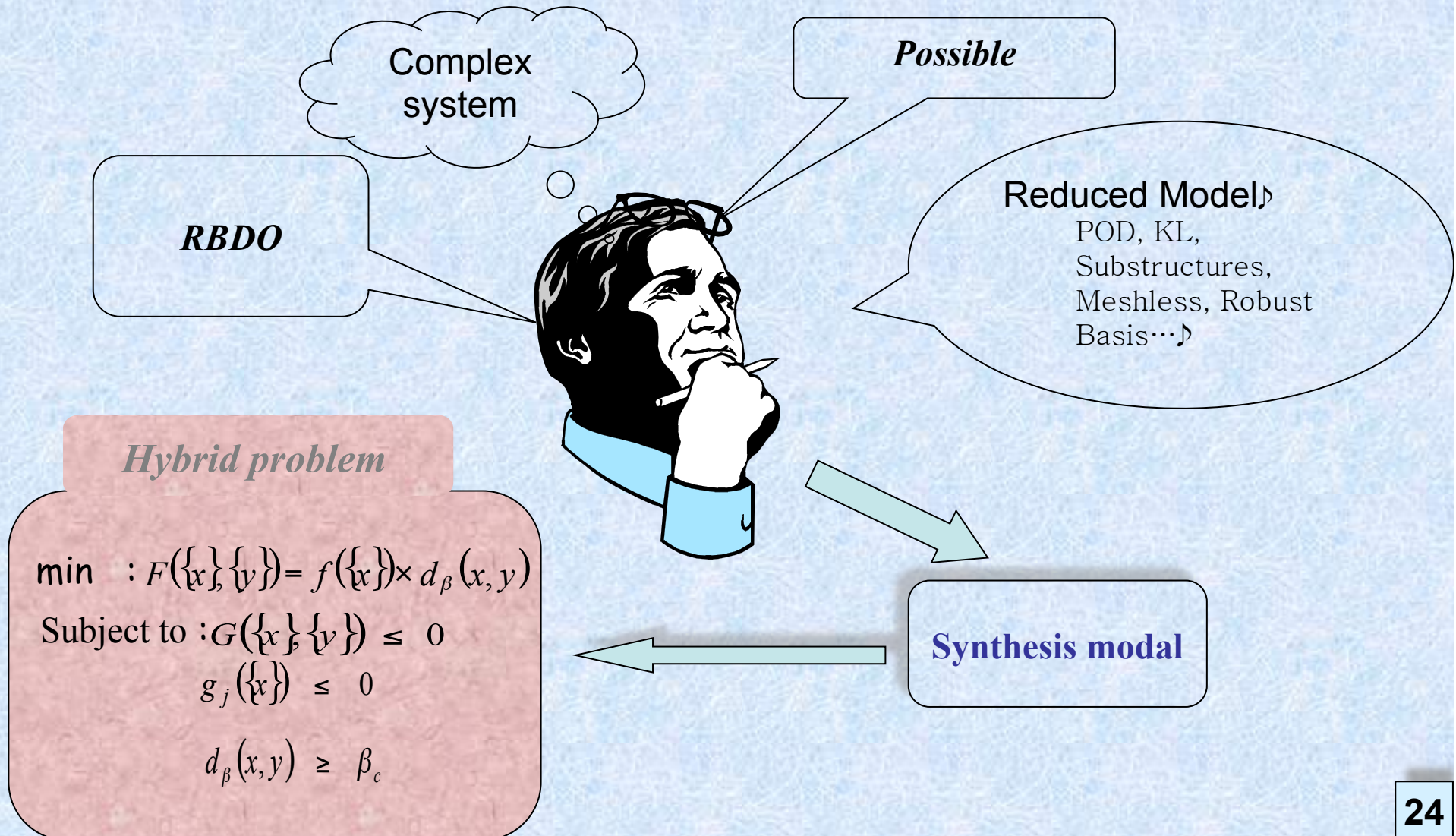
Reduction of Computing Time 80%

Optimisation on Reliability and Dynamic Response Analysis of a Spring Cylinder for Trucks Brake system

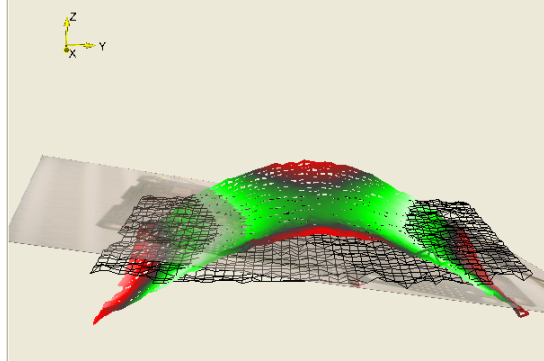
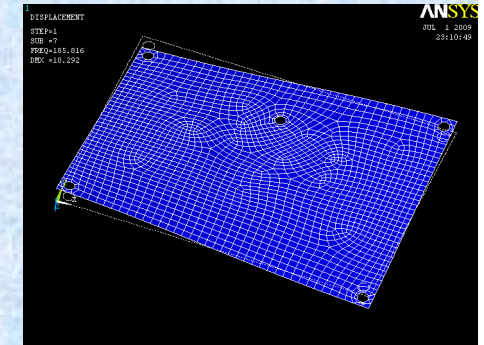
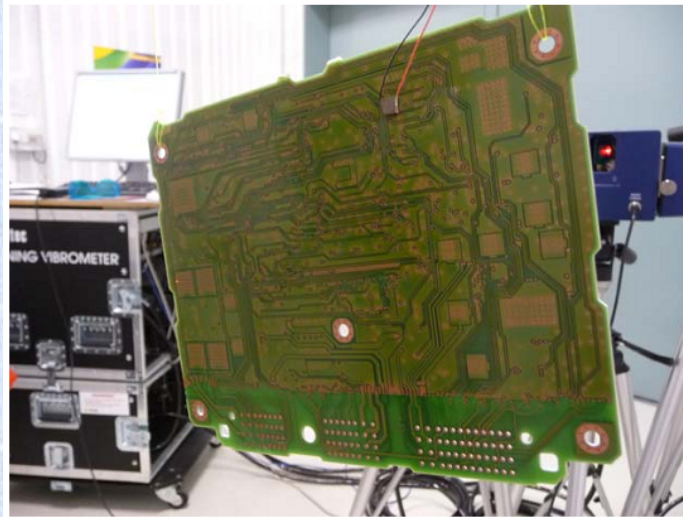
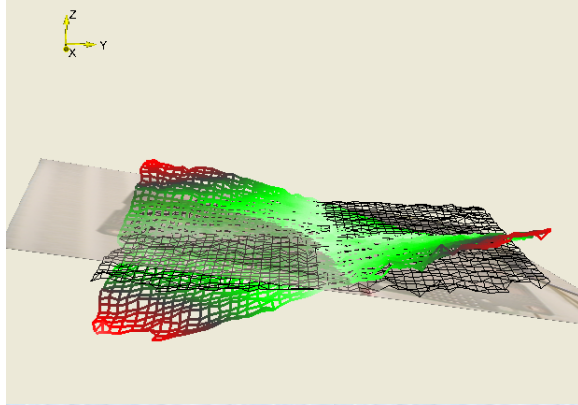
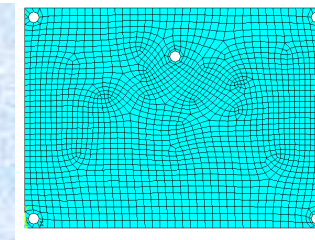
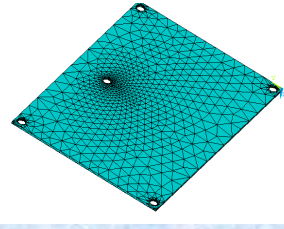


- Iteration History

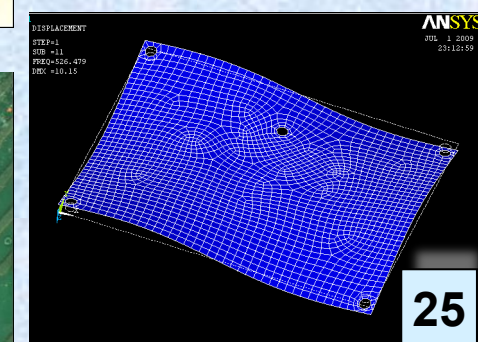
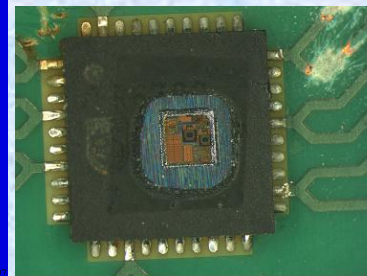
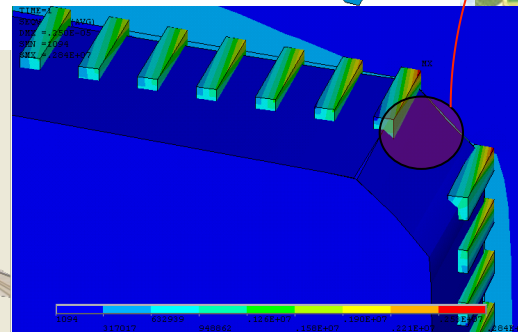
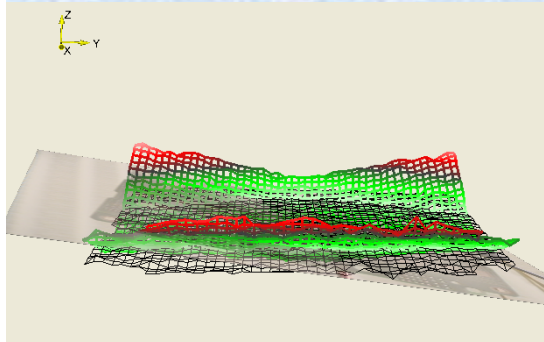
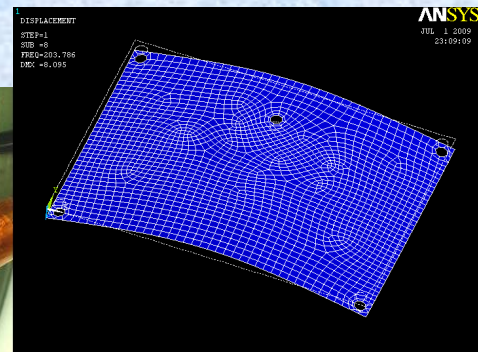
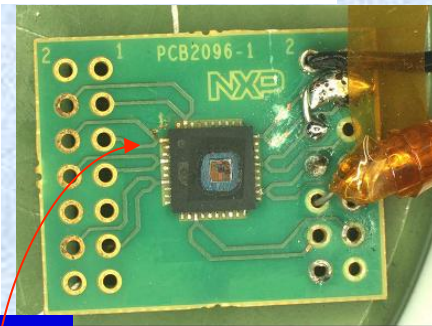
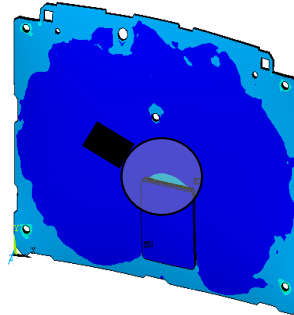
Integrate the method of Synthesis modal into the hybrid RBDO



Applications



DISP (AVG)
DMX = 1.250E-05
DMY = 1.094E-07
DMZ = 1.204E-07



Conclusion

- **Best compromise between the cost and the safety**
- **Solution in a hybrid space**
- **RBDO + Sub-structures**
- **Calculation time for real embedded electronics and mechatronical system.**