INTENSIVE WORKSHOP
INTELLIGENT OPTIMAL DESIGN OF MATERIALS AND STRUCTURES

Animated by
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November 27-29, 2000

THE AIM OF THE WORKSHOP:
The designers of materials and structures are often compelled to make decisions under uncertain conditions, seeking solutions to problems which do not have known solutions. These include constitutive modeling, fatigue life prediction, wear, friction, or prediction of errors of inelastic analysis of structures.
This workshop will provide, with the help of explicit examples, the bases and the use of a new approach to deal with such design problems using the available expert knowledge, experimental data and computational tools. This approach has been developed at the Laboratoire de Mécanique des Solides de l'Ecole Polytechnique (France). It is based on coupling the existing knowledge of experts, numerical results, and experimental data, with special automatic learning and optimization techniques.
The workshop first reviews some basic issues relating to materials and structures, as well as Symbolic-Numerical Automatic Learning, and Optimization Schemes. Then, according to the needs of the participants, examples of applications to optimization of processes and formulation of material input, direct coupling with CAD Systems, optimal design of structures for random or cyclic loading, control of processes, and non-destructive tests.
The participants will be provided with a thorough grounding in this new approach. This will be achieved through a balance of lectures, demonstrations, and discussion of their own problems.

WHO SHOULD ATTEND THE WORSHOP:
The intensive 3 day-workshop is dedicated to Mechanical and Civil Engineers and researchers who have to design structures subjected to any kind of loading such as elevated temperatures and high pressures, dynamic loads in CRASH, rolling and wear, etc. Practical exercises, training on special examples will allow the participants to assimilate the principles of this approach. Moreover, practical applications to time-life prediction in fatigue-corrosion, to materials processes, to modeling of materials and direct link to CAD systems will be made to show the exceptional potentials of the new approach for the Mechanical Engineering, the Civil Engineering, Automotive, and the Aeronautical Industries. The participants will have an opportunity to present their own problems on posters and to listen to the advise of the audience and the instructor of the workshop.
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WORKSHOP CONTENT:
For this approach, it is necessary:
    i) to build a DATABASE of examples, i.e., to obtain some experimental, an real or simulated results, where the EXPERTS indicate all variables or descriptors which are essential to the considered problem. This is, at first, done with some PRIMITIVE descriptors x which are usually of a limited number. Then, the data are transformed into INTELLIGENT descriptors XX of a larger number, using the existing knowledge (usually insufficient) and theories. These descriptors may be numbers, Boolean or alphanumeric, names of files which give access to data bases, or curves, signals, and images. The results or conclusions may be classes (good, not good, ...) or numbers;
    ii) to generate the RULES using any Automatic Learning Tool. Each conclusion is explained as function (or set of rules) of some of the input intelligent descriptors, together with a known reliability or accuracy measure;
    and iii) to optimize at two levels (the Inverse Problems).
        * Considering the intelligent descriptors as independent, it is possible to get the OPTIMAL SOLUTION satisfying the special required properties and allowing the DISCOVERY OF NEW MECHANISMS,
        * Considering the intelligent descriptors linked to primitive descriptors, it is possible to obtain the optimal solution which is technologically possible.
So, not only a Practical Optimal Solution is obtained, but also the experts may learn the missing parts, may build models or theories based only on the retained intelligent descriptors and guided by the structure of the rules or relationships. The same methodology applies in other classes of problems, but the workshop will focus only on the potentials of the approach to solve problems in Mechanical Engineering, Civil Engineering, Automotive and Aeronautical Industries .

QUESTIONS:
• When can I use the entire knowledge existing in my company?
• How can I identify the inherent barriers to constitutive modeling and structural analysis?
• Where can I learn the automatic learning and optimization techniques?
• How can I obtain the real optimal design for my structures?
• Are there any successful applications already in use?

• How can I use what I learned in the workshop upon returning to my company?
The workshop will answer these questions, and will ensure that immediately after its completion, that the participants are able to use many of the principles and the tools that you have learned in your profession

If you need any more informations regarding the workshops content, please contact the workshop animator:
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Tel: 33 1 69 33 33 72 Fax: 33 1 69 33 30 26 Email: zarka@lms.polytechnique.fr
Directeur de Recherches au CNRS au Laboratoire de Mécanique des Solides, Ecole Polytechnique, France, holds a Dr. es-sciences degree from University of Paris (1968) and a Civil-Mechanical Engineering diploma from Ecole Polytechnique (1962). He was the Scientific Director of the CETIM (1981 to 1986), the research center of the French mechanical industries. Since 1986, he participated in developing several consultant companies such as CADLM (which is a research center for mechanical, civil-engineering, transportation, off-shore and military industries) where he is the Scientific Director of the department on "Intelligent Optimal Design of Materials and Structures". His previous scientific interests were in micromechanical constitutive modeling of materials, numerical analysis of structures, new formulations and simplified analysis of inelastic structures and non-destructive tests. His current research interests are towards a new approach for INTELLIGENT optimal design of materials and structures, control of fabrication and survey of structures. He has been recently elected Fellow of ASME. He has co-edited three books in English with S. Nemat-Nasser, J. Gittus and some of his co-workers. He has published over one hundred scientific papers and has presented over one hundred lectures internationally.

Prof. B. Baumann, professor of Physics at the University of Applied Sciences in Hamburg since 1992, was a visiting graduate student in the Supercomputer Computations Research Institute in Tallahassee, Florida, USA. He got his Ph.D. in 1987, afterwards project management in information technology. His current research interests are in Monte Carlo simulations, Stochastic Optimization and Finite Element Method. He will review the optimization.

WORKSHOP AGENDA
Monday :
1. Review Barriers in Constitutive Modeling and in Structural Analysis	9:00-10:00
2. Review Expert Systems: machine learning and numerical machine learning, neural network	10:15-12:00

Lunch, Pause, Individual Work
3. Review of Optimization: classical algorithms and genetic algorithms	3:00-4:30
4. Exercises	4:45-6:00

Tuesday :
5. Principles of Intelligent Optimal Design	9:00-12:00

Lunch, Pause, Individual Work
6. Examples of Designs of Materials	3:00-5:00
7. Exercises	5:00-6:00
BANQUET	7:00-TBA

Wednesday :
8. Examples of Optimal Design of Structures, Processes and Testing	9:00-12:00

Lunch, Pause, Individual Work
9. Presentation of Problems by Participants	3:00-6:00

REGISTRATION INFORMATION:
Registrations will be taken in the order of receipt, as the workshop will accommodate a limited number of persons.
The tuition for the full three day workshop is 4 000 FF HT ($ 600), if received by two months in advance, and 5 500 FF HT ($ 800) if received after. A reduced fee of 1 200 FF HT ($ 200) is accessed for those registrants who are professors or students for a two months advanced registration, and 2 500 FF HT ($ 400) if received later. The registration fee includes the documents, all luncheons, coffe break and the banquet. Registrants who cancel one month prior to the workshop will be reimbursed the registration fee minus $50 handling charge; cancellations less than fifteen days prior to the workshop will be refunded 50%. *Notes: the organizers will maintain the right to cancel the workshop in case of insufficient number of participants, or to modify slightly the program if need be.*
For all university affiliates who confirm their participation before September 15, 2000, , there will be no registration fee; they will have to pay only for the meals and the banquet 600 F HT ($ 100).

WORKSHOP : INTELLIGENT OPTIMAL DESIGN MATERIALS AND STRUCTURES

November 2000   **Industrial participant ☐   or University affiliate ☐**
Name: Institution Name   Department:
Address:
Telephone: Fax: Email:
Fields of interest:
Please send your registration form to: Mr Alain Benchissou, CADLM, 9 rue Raoul Dautry, 91190 Gif/Yvette (France), email: cadlm@wanadoo.fr with a check payable to CADLM *Zarka Worksho*p.