Cicli di seminari della
SCUOLA DI DOTTORATO
IN INGEGNERIA CIVILE E INDUSTRIALE

UNICUSANO
Università degli Studi Niccolò Cusano - Telematica Roma

Applied Fuzzy Arithmetic in Engineering

26 Gennaio 2018
aula IV ore 15:30-17.30
Via Don Carlo Gnocchi 3, Roma, 00166

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Abstract
A common problem in the numerical simulation of complex real-world systems is the fact that the parameters of the models usually exhibit some degree of uncertainty and exact values for their quantification can hardly be provided. This non-determinism in numerical models may arise as a consequence of different sources: natural variability or scatter, which is often referred to as aleatory uncertainties, as well as so-called epistemic uncertainties, which arise from an absence of information, vagueness in parameter definition, subjectivity in numerical implementation, or simplification and idealization as it usually appears in every modeling procedure.
Aleatory uncertainties have successfully been taken into account by the use of probability theory, in particular if sufficient data is available to derive probability density functions. The modeling of epistemic uncertainties, i.e. the inclusion of vague knowledge or imprecision, however, still remains a challenging topic. As a practical approach to solve this limitation, an interdisciplinary methodology to an advanced modeling and analysis of systems is presented, which allows for the inclusion of uncertainties from the very beginning of the modeling procedure. This approach is based on fuzzy arithmetic, a special field of fuzzy set theory, where the uncertain values of the model parameters are represented by so-called fuzzy numbers. Those fuzzy numbers do not only reflect in a rather intuitive and plausible way the blurred range of possible parameter values, they can also be seen as a possibilistic enclosure of imprecise probabilities in the case of insufficient knowledge. As a result of this advanced modeling technique, more comprehensive system models can be derived which outperform the conventional, crisp-parameterized models by providing simulation results which reflect both the system dynamics and the effect of the uncertainties.
In the seminar, the fundamentals of fuzzy set theory and fuzzy arithmetic are introduced from scratch, and the chances and challenges of fuzzy arithmetical uncertainty analysis are discussed and illustrated by some exemplary applications from the fields of mechanical engineering and control engineering. Furthermore, the relation between fuzzy arithmetic and probability theory is extensively elucidated, and an approach to optimization under uncertainty is presented in the framework of robust controller design.

Short C.V.

Professional Career

June 22, 1965 born in Ravensburg

1991	Graduation in Engineering Cybernetics (Dipl.-Ing.), University of Stuttgart
1991 – 2011	Research Associate and Adjunct Professor at the Institute A of Mechanics (from 2006: Institute of Applied and Experimental Mechanics), University of Stuttgart
12/1998	Doctoral Degree (Dr.-Ing.), University of Stuttgart
10/2004	Habilitation Degree, University of Stuttgart
since 2011	Adjunct Professor at the Institute of Engineering and Computational Mechanics, University of Stuttgart

Main Research Areas

Uncertainty analysis, fuzzy methods, structural dynamics, nonlinear oscillations.

Awards and Recognitions

"Most Active SMC Technical Committee Award" awarded by the IEEE Systems, Man, and Cybernetics Society, October 2006

Scientific Guidance

Total number of supervised doctoral candidates as first or second examiner (since 2007): 25

Publication Productivity

Total number of publications (since 1994): 131
(47 articles in books or peer-reviewed journals, 3 books, 81 papers in conference proceedings)
Current h-index: 16