

**FIRST IFAC WORKSHOP  
ON FRACTIONAL DIFFERENTIATION AND ITS APPLICATION**  
19-21 JULY 2004, ENSEIRB, BORDEAUX, FRANCE - FDA'04

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Edited by **A. Le Mehauté**, **J. A. Tenreiro Machado**, **J. C. Trigeassou** and **J. Sabatier**.

<http://www.lap.u-bordeaux.fr/fda04/home.html>

In the last two decades, fractional differentiation (fractional calculus, fractional order derivative) has played a very important role in various fields such as mechanics, electricity, chemistry, biology, economics and notably control theory, robotics and image and signal processing. In this last field, some important considerations such as modeling, curve fitting, filtering, pattern recognition, edge detection, system identification, stability, controllability, observability and robustness are now linked to long-range dependence phenomena.

Fractional differentiation, fractional order derivative and its applications in automatic control and signal and image processing is thus now an important issue for the international scientific community.



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*The Chairman of the International Program Committee was* **S. Samko** (Portugal) and Co-chairman was **A. Oustaloup** (France).

*Editors of the Proceedings are:* **A. Le Mehauté** (France), **J. A. Tenreiro Machado** (Portugal), **J. C. Trigeassou** (France) and **J. Sabatier** (France)

Proceedings contain the following **KEYNOTE PAPERS:**

*Plenary Lectures:*

- \* ***New Engineering and design tools based on fractional differentiation*** written by Alain Le Mehaute and Raoul R. Nigmatullin
- \* ***Fractional splines, wavelet bases and applications*** written by Michael Unser.
- \* ***Power laws, random walks, and fractional diffusion processes as well-scaled refinement limits*** written by Rudolf Gorenflo and Francesco Mainardi.

*Round table talk:*

- \* ***New trends on differential equations*** written by Anatoly A. Kilbas.

*Session: List of topics*

The following areas were covered by the workshop: representation tools, analysis tools, synthesis tools, simulation tools, modeling, system identification, observation, control, vibration insulation, filtering, pattern recognition, edge detection

The following disciplines are thus mainly concerned:

- Electrical engineering*** (modeling of motors, modeling of transformers, skin effect, ...);
- Electronics, telecommunications*** (phase locking loops, ...);
- Electromagnetism*** (modeling of complex dielectric materials, ...);
- Electrochemistry*** (modeling of batteries, ...);
- Thermal engineering*** (modeling and identification of thermal systems, ...);
- Mechanics, mechatronics*** (vibration insulation, ...);
- Rheology*** (behavior identification of materials, ...);
- Automatic control*** (robust control, system identification, observation and control of fractional systems, ...);
- Robotics*** (modeling, path tracking, path planning, ...);
- Signal processing*** (filtering, restoration, reconstruction, analysis of fractal noises, ...);

Proceedings contain contributed papers classified in the following chapters with respect to the Workshop sessions:

- \* Fractional Differentiation in Materials Modeling I - Physical aspects
- \* Application of Fractional Differentiation in Physical and Biological Systems Modeling
- Mathematical tools
- \* Control
- \* System Identification I - Identification methods
- \* Software for Fractional Systems
- \* Technological Transfers
- \* Fractional Differentiation in Materials Modeling II - Constitutive laws and vibrations
- \* Fractional Differentiation in Materials Modeling II - Constitutive laws and vibrations
- \* System Identification II – Applications
- \* Implementation/Discretisation of Fractional Operators
- \* Application of Fractional Differentiation in Thermal and Fluid Systems Modeling
- \* Application of Fractional Differentiation in Electrical Engineering
- \* Implementation/Discretisation of Fractional Operators II
- \* Anomalous transports / Random walks
- \* Control
- \* Application of fractional differentiation in Control, Robotics and Mechatronics

- \* Fractional diffusion equations and their applications
- \* Fractional systems analysis
- \* Fractional Differentiation in Materials Modeling III - Applications
- \* Numerical Methods for Fractional Systems



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Participants T. M. Atanackovic, K. (Stevanović) Hedrih, V.D. Djordjevic and D. T. Spasic, from Serbia (left photo), and O. P. Agrawal (USA) with colleague in the break of the Workshop (right photo).

From Serbia and Montenegro the following papers were presented at the Congress and published in the Proceedings:

\* **MODELING OF THE SLIP BOUNDARY CONDITION IN RAREFIED GAS MICROCHANNEL FLOW VIA FRACTIONAL DERIVATIVE** written by V. D. Djordjevic, in session *Application of Fractional Differentiation in Thermal and Fluid Systems Modeling*.

\* **PARTIAL FRACTIONAL ORDER DIFFERENTIAL EQUATIONS OF TRANSVERSAL VIBRATIONS OF CREEP-CONNECTED DOUBLE PLATE SYSTEM** written by K. (Stevanović) Hedrih in session *Fractional Differentiation in Materials Modeling - Constitutive laws and vibrations*.

\* **FRACTIONAL OSCILLATORS: FORMULATIONS AND SOME PROPERTIES OF THE SOLUTION** written by T. M. Atanackovic in session *Fractional systems analysis*.

\* **A NOTE ON AIRPLANE LANDING PROBLEM** written by D. T. Spasic, M. Nedeljkov and M. Milutinovic

in session **Fractional Differentiation in Materials Modeling – Applications**.

Among the referees of the papers submitted for Workshop IFAC Proceedings-Preprints were: T. M. Atanackovic, K. (Stevanović) Hedrih and D. T. Spasic, from Serbia.

For concluding remarks we can write that the Workshop and Proceedings have covered the general areas of the theory and practice of fractional differentiation (fractional calculus, fractional order derivative) and its applications in many disparate areas, and they also include multidisciplinary and interdisciplinary problems.

The scientific and technical program was included:

- \* General lectures by internationally noted scientists and engineers on topics of fractional calculus and applications;
- \* Informal forums on topics of important relevance for scientists and researchers - theoreticians and designers to maximize the extensive exchange of ideas among the Workshop attendees.

Topics were in the field of health, technology transfer, robotics, design, economics, computers, space, quality of life, environment, communications, transportation, etc. This workshop thus aims at gathering the experts in the field of fractional differentiation and its applications, and all interested researchers, coming from universities and industries, in order to make the point on the state of the art and on current research lines in theory, methodology, applications and tools.



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One of the Proceedings Editors J. A. Tenreiro Machado

ISEP-Institute of Engineering of Porto with colleagues in the break of the Workshop (right photo).



FDA'04. Workshop Co-chairman A. Oustaloup (France) with participants in Saint Emilion.