# MODELLING WITH FRACTIONAL CALCULUS: FROM MATHEMATICAL CURIOSITY TO REAL LIFE PROCESSES AND MATERIALS

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*Dedicated to the memory of Professor Anatoly Kilbas*

The foundation of the Fractional Calculus goes back to the end of XVII century. First, the derivative of a fractional order appeared as a game of mathematical intelligence. This game was developed by several generations of scientists. Nobody could predict an essentially rapid grow of the interest to this subject from representative of different branches of Science, Engineering, Medicine, Economics etc., which one can observe in the recent couple of decades. This interest is related to several features of the subject emphasized — the technique is fairly simple, the models built on the base on such method is highly applicable in different areas of science and human life, the novel models are useful to describe new features of real materials and processes, they allow to take a fresh look at well-known objects. Recent advances of fractional calculus are dominated by modern examples of applications in differential and integral equations, physics, signal processing, fluid mechanics, viscoelasticity, mathematical biology, and electrochemistry. There is no doubt that fractional calculus has become an exciting new mathematical method of solution of diverse problems in mathematics, science, and engineering.

First of all, we deal with some classical examples of applications of the fractional modeling coming from rheology, electrochemistry and medicine. Second we briefly describe the history of the development of the Fractional Calculus paying attention to the characteristic features of fractional derivatives and integrals. This part of the lecture gives an insight to the specific peculiarities of the fractional technique. The relation of the constructions by L. Euler, by B. Riemann and J. Liouville, by J.-B. Fourier, by A.K. Grünwald and A.V. Letnikov, by M. Riesz and by M.C aputo to the standard mathematical objects are discussed. Next question to answer is "how people arrive to the necessity of the use of such mathematical objects in their research"? We illustrate the properties which are core of the fractional method using several examples of applications. We conclude the lecture with some practical recommendations of possible use of the fractional models in different subjects.

**Acknowledgements.** The lecture is based on the lecture delivered at the Institute of Advanced Studies, Bologna University (May 23rd, 2017). The work is partially supported by Belarusian Fund for Fundamental Scientific Research (grant F17MS–002).