

# Preface

This short monograph is a spin-off of the author's "Fractional Differentiation Inequalities," a research monograph published by Springer, New York, 2009. It continues and complements the earlier book to various interesting and important directions.

In this short monograph we use primarily the Caputo fractional derivative, as the most important in applications, and we present first fractional differentiation inequalities of Opial type where we involve the so-called balanced fractional derivatives. We continue with right and mixed fractional differentiation Ostrowski inequalities in the univariate and multivariate cases.

Then we present right and left, as well as mixed, Landau fractional differentiation inequalities in the univariate and multivariate cases.

The inequalities are given for various norms.

Fractional differentiation inequalities are by themselves an important and great mathematical topic for research. Furthermore they have many applications, the most important ones are in establishing uniqueness of solution in fractional differential equations and systems and in fractional partial differential equations. Also they provide upper bounds to the solutions of the above equations.

In this brief monograph we give several applications.

Each chapter is self-contained and can be read independently of the others and several graduate courses and seminars can be taught out of this monograph.

The final preparation of this book took place in Memphis, USA, during 2010–2011.

Fractional calculus has become very useful over the last 40 years due to its many applications in almost all applied sciences. We see now applications in acoustic wave propagation in inhomogeneous porous material, diffusive transport, fluid flow, dynamical processes in self-similar structures, dynamics of earthquakes, optics, geology, viscoelastic materials, biosciences, bioengineering, medicine, economics, probability and statistics, astrophysics, chemical engineering, physics, splines, tomography, fluid mechanics, electromagnetic waves, nonlinear control, signal processing, control of power electronics, converters, chaotic dynamics, polymer

science, proteins, polymer physics, electrochemistry, statistical physics, rheology, thermodynamics, neural networks, etc. By now almost all fields of research in science and engineering use fractional calculus as better describing them.

So as expected this book being a part of fractional calculus is useful for researchers and graduate students for research, seminars and advanced graduate courses, in pure and applied mathematics, engineering, and all other applied sciences.

I would like to thank my family members for their support and for their tolerance to accept my continuous mathematics habit. Also I am greatly indebted and thankful to my Ph.D. student Razvan Mezei for the heroic and fantastic technical preparation of the manuscript in a very short time.

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