Mechanical Engineering Graduate Program @ UC Merced
ME291 ME Seminar Series
Presents

Fractional Derivatives and Their Applications

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Friday, Oct. 11, 2019. 2:00-3:20pm; Location: CLSSRM 110

ABSTRACT:

Considerable progress has been made in the area of Fractional Derivatives and Their Applications in the last two decades. Fractional Calculus is now being used in almost every field of science, engineering, and applied mathematics. However, many researchers still remain unaware of this field, and very few universities offer courses in this area at the graduate level and almost none at the undergraduate level.

When people hear about the fractional derivatives, they often ask: What is a fractional derivative? Are there applications of this field? What are those applications? Is this subject very difficult? In this talk, I will introduce the concept of fractional derivatives and present several of its applications. I plan to formulate the following problems: The Tautochrone, Flow through a channel, Model of a disk brake, Lossy RC transmission line, Model of a real capacitor, Elastic bar on a viscoelastic surface, Shear stress in a fluid, and Motion of a plate in a Newtonian fluid. I will discuss application of fractional derivatives in modeling of disk brakes in detail, and compare analytical and numerical results for the problem. I will also demonstrate that one can use the tools and the techniques developed in this field without much knowledge of mathematics behind the subject. To demonstrate this, I will introduce a simulink half-order integrator block and discuss its applications in fractional integration of a function. I will also discuss the solution of a fractional differential equation and fractional order control. I will present some statistical data to show the growth of this field in the last three decades. I will also discuss current research areas where Fractional Calculus is being applied and used to unify fundamental laws.

BIOGRAPHY: Dr. Agrawal graduated with Ph.D. degree from University of Illinois at Chicago in 1984. After working

for one year at Temple University, Philadelphia, PA, he joined Southern Illinois University in Carbondale (SIUC), IL in 1985. After working for 34 years at SIUC, he retired from the university in June of this year. He is now an emeritus professor of SIUC.

Prof. Agrawal initially worked in the area of Flexible Multibody Dynamics. Since 1997, he has been actively involved in promoting the area of Fractional Derivatives and Their Applications. He has made significant contributions to the field including: Formulation of fractional variational calculus and fractional Euler-Lagrange equations, Deterministic and stochastic analysis of fractional dynamic and fractional optimal control systems, and analytical and numerical tools and techniques for fractional systems. Prof. Agrawal has published over 150 journal/conference papers and book chapters. One of his works has recently been called the Agrawal Principle by some experts in the field. Prof. Agrawal has been a plenary keynote speaker and invited speaker at several symposia, conferences, and universities. He is one of the Research Scholar of SIUC. He has received various awards for his contributions in the field of Fractional Derivatives. According to google search, he has been cited close to 9000 times, and thus his work has been widely cited.

In 2003, he organized a symposium on Fractional Derivatives and Their Applications (FDTAs) in Chicago. It was the first symposium to bring together at one place many people from different fields (engineering, science, economics and finance, mathematics, and bioengineering) working on applications of Fractional Derivatives. Since then, he has organized several symposiums in the field, and he has been a member of almost all symposiums, conferences and workshops organized in this field. In 2003 symposium, he also formed a consortium/organization to promote FDTAs. In 2004, Professor Agrawal led a US team in a US-French collaboration on Fractional Derivatives and Their Applications.

Along with Prof. Tenreiro Machado and Dr. Sabatier, Prof. Agrawal has co-edited a special issue of Nonlinear Dynamics and a book on Recent Advances in Fractional Calculus. Prof. Agrawal is an associate editor of the Journal of Computational and Nonlinear Dynamics and the Indian Journal of Theoretical Physics. He is also a member of the editorial board of the International Journal of Differential Equations and Fractional Dynamic Systems. I addition, he has been an invited guest editor of special issues of FDTAs.

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