SIAM @ UC Merced Presents**:**

What is, why you need and who cares fractional calculus!

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(Mechatronics, Embedded Systems, and Automation)
School of Engineering
University of California at Merced

Talk location and time:

November 08, 2013, 3:30-4:30 @ Room COB 265

Abstract

Fractional calculus (FC) is about differentiation and integration of non-integer orders. FC is a generalization of the traditional (integer order) calculus. Many real world man-made and natural systems are better characterized using a non-integer order dynamic model based on "fractional calculus". The concept of fractional calculus has tremendous potential to change the way we see, model, and control the nature around us. Denying fractional derivatives is like saying that zero, fractional, or irrational numbers do not exist. After briefly introducing the basics of fractional calculus, I will try to make a convincing case that "fractional order thinking" is ubiquitous with numerous potential engineering applications with an emphasis on dynamic systems controls and signal processing. I will explain why you need fractional calculus if you want "more optimal" results. The talk has 4 parts: "What", "Why", "Who Cares" and "Take-home Messages".

About the speaker: YangQuan Chen was a faculty member of ECE Dept. of Utah State University before he joined UC Merced in Fall 2012. He earned his Ph.D. from Nanyang Technological University, Singapore in 1998, MSc. from Beijing Institute of Technology in 1989 and BS. from University of Science and Technology of Beijing in 1985. His current areas of research interests include: distributed measurement and distributed control of distributed parameter systems using mobile actuator and sensor networks, smart mechatronics and process controls, applied fractional calculus in controls, signal processing and energy informatics, multi-UAV based personal cooperative remote sensing and real time water management and irrigation control.

Dr. Chen is an Associate Editor on the Conference Editorial Board of the Control Systems Society of the IEEE (since 2002), an Associate Editor on the International Society of Automation (ISA) Editorial Board for the American Control Conference (since 2004) and an Associate Editor on the Conference Editorial Board of the Robotics and Automation Society of the IEEE (since 2012). He served as the General Chair for IEEE/ASME Int. Conf. on Mechatronics and Embedded Systems Applications (MESA) 2010, Qingdao, China and the Program Chair for the ASME/IEEE Int. Conf. on MESA, Las Vegas, NV, 2007 and MESA09 San Diego, CA, 2009 and Program Co-Chair for the IEEE International Conference on Mechatronics and Automation for 2006 and 2007. He was the TC Chair for MESA under ASME DED, Chair for MES for IEEE ITSS, and is a member of IFAC TC2.2. He serves as an Associate Editor for *Acta Montanistica Slovaca*, *Fractional Calculus and Applied Analysis (FCAA)*, *ASME J. of Dynamic Systems, Measurement and Control*, *International Journal of Advanced Robotic Systems*, IFAC journal *Mechatronics* , *ISA Transactions*, *IEEE Transactions on Control Systems Technology (TCST)*, and *IFAC journal Control Engineering Practice (CEP).* Dr. Chen is a member of Editorial Advisory Board of *An International Journal of Optimization and Control: Theories & Applications (IJOCTA).* He won IFAC Journal of *Control Engineering Practice* Best Paper Award at 2011 IFAC World Congress. Since 2012, Dr. Chen serves as TC Co-Chair for IEEE RAS Technical Committee on Aerial Robotics and Unmanned Aerial Vehicles.

Dr. Chen is a senior member of IEEE, a member of ASME, AUVSI, AMA (Academy of Model Aeronautics), AWRA (American Water Resources Association) and ASEE (American Society of Engineering Educators).

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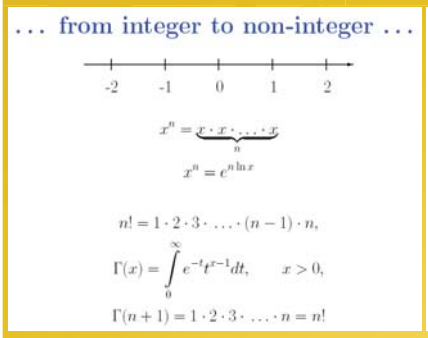
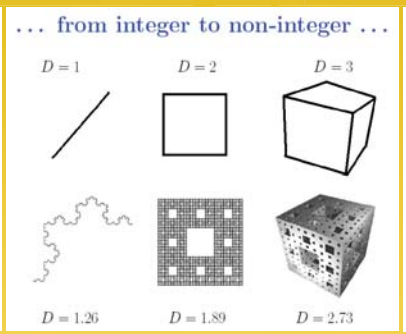
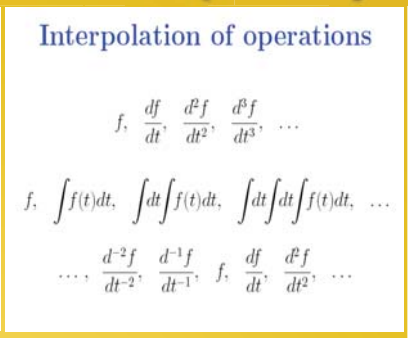
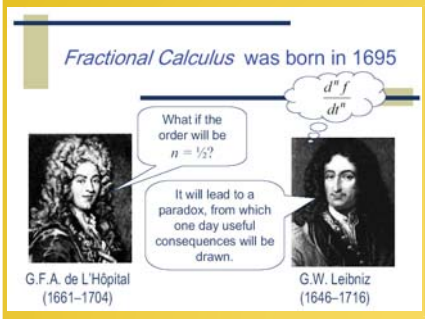
http://mechatronics.ucmerced.edu

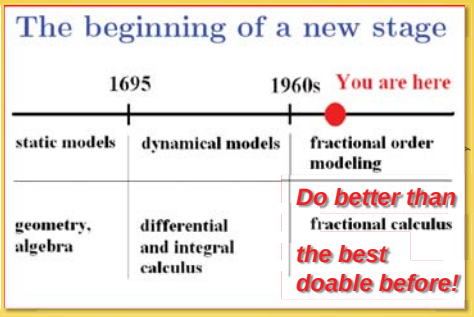
APPLIED FRACTIONAL CALCULUS (AFC)



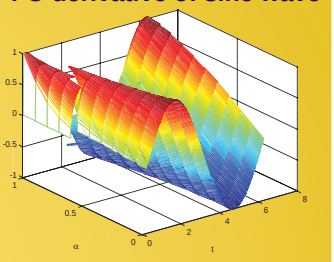








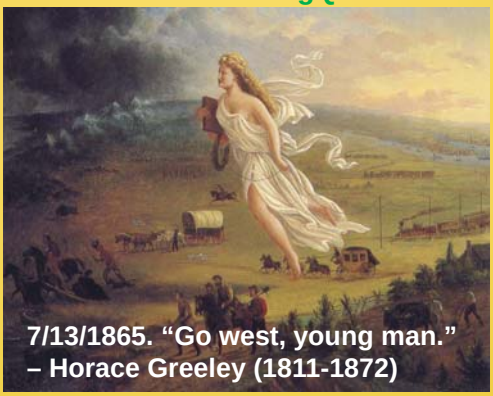
FO derivative of sine wave

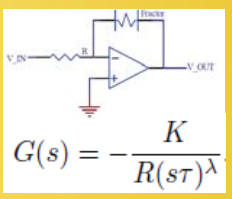


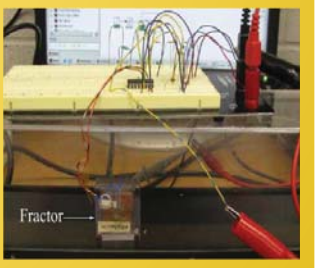
Rule of thumb

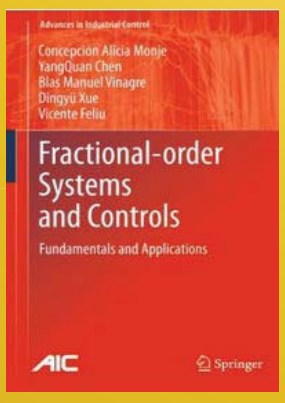
- Power law, Scale-free, scale invariant
- Heavy tailedness, fat tail
- Long range dependence (LRD)
- Porous media, Anomaly
- Soil, tissue, electrodes, bio, nano, network, transport, diffusion, soft matters (**bio**x) …

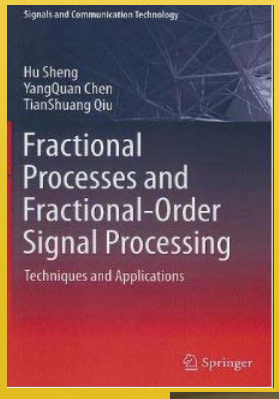
"Go fractional!" – YangQuan Chen

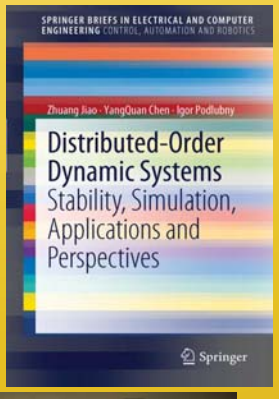


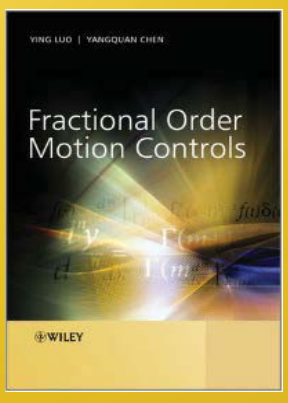












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