

# **Don Quixote and the Windmills**

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Fractional Calculus (FC) started in 1695 when L'Hôpital wrote a letter to Leibniz asking for the meaning of  $D^n y$  for  $n = 1/2$ . Starting with the ideas of Leibniz many important mathematicians developed the theoretical concepts. By the beginning of the twentieth century Olivier Heaviside applied FC in the electrical engineering, but, the visionary and important contributions were forgotten. Only during the eighties FC emerged associated with phenomena such as fractal and chaos and, consequently, in nonlinear dynamical. In the last years, FC become 'new' tool for the analysis of dynamical systems. FC is now recognized to be an important tool to model and control systems with long range memory effects. This lecture introduces briefly the FC fundamental concepts and presents classical and new applications in distinct areas of science and engineering.