SOME REAL LIFE APPLICATIONS OF FRACTIONAL CALCULUS

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Abstract. Three real life applications for fractional calculus are given. Nuclear (strong) interactions, earthquake prediction and epidemics.

1. Nuclear (strong) interactions

Infinitesimally deformed oscillator algebra corresponds to a Heisenberg relation which may explain confinement. There is a correspondence between $q$-deformed oscillators and fractional order ones. This result has been confirmed experimentally by Herrmann [1], [2] who showed that $\alpha = 2/3$ corresponds to hadrons and $\alpha \approx 3/4$, $4/5$ correspond to mesons. Using semi-simple Lie algebra [3] to model particle physics leads naturally to using the deformed $SO_q(2,3)$ group. Deformed algebra is naturally related to fractional calculus and to strong interactions.

Galilean group $\Rightarrow$ (semisimple) Lorentz group. 
Poincare group $\Rightarrow$ $SO(2,3)$
Including $SU(2) \times U(1)$ may $\Rightarrow$ $SO_q(2,3)$.

The main conclusion is that the algebra corresponding to strong interaction seems to be Hopf (deformed) algebra and that strong interactions are intrinsically related to fractional calculus.

2. Earthquake prediction[4]

So far we have failed in earthquake prediction even for short range prediction. Earthquakes are known to occur on fractures which are fractals. Fractals, by definition are continuous nowhere differentiable functions hence only fractional calculus can be used to study them. Earthquakes are expected to increase hence studying them is quite important.

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3. Epidemics

Studying epidemics is an important problem. It is known that the present state of a patient depends on his/her past history. Therefore mathematical models for epidemics need fractional calculus [5]. Several other engineering applications for fractional calculus are given in [6].

References


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