A mechanical approach to fractional non-local thermoelasticity

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In recent years fractional differential calculus applications have been developed in physics, chemistry as well as in engineering fields. Fractional order integrals and derivatives extend the well-known definitions of integer-order primitives and derivatives of the ordinary differential calculus to real-order operators.
Engineering applications of these concepts dealt with viscoelastic models, stochastic dynamics as well as with the, recently developed, fractional-order thermoelasticity [3]. In these fields the main use of fractional operators has been concerned with the interpolation between the heat flux and its time-rate of change, that is related to the well-known *second sound* effect. In other recent studies [2] a fractional, non-local thermoelastic model has been proposed as a particular case of the non-local, integral, thermoelasticity introduced at the mid of the seventies [1].
In this study the autors aim to provide a mechanical framework to account for fractional, non-local effects in thermoelasticity. A mechanical model that corresponds to long-range heat flux is introduced and, on this basis, a modified version of the Fourier heat flux equation is obtained. Such an equation involves spatial Marchaud fractional derivatives of the temperature field as well as Riemann-Liouville fractional derivatives of the heat flux with respect to time variable to account for *second sound* effects.

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2. Povstenko, Y. Z. 2009 *Theory of termoelasticiy based on the space-time-fractional heat conduction equation.* Phys. Scr. T136, 014017.

3. Sherief, H. H.; El-Sayed, A.M.A.; Abd El-Latief, A.M., 2010 *Fractional order theory of thermoelasticity.* Int. J. Sol. Str., 47,269–275.