

Fractional differential equation modeling a viscoelastic fluid in mass-spring-magnetorheological damper mechanical system

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Abstract

The mass-spring-damper system is the minimum complexity scenario that characterizes almost all the mechanical vibration phenomena, it is well known that a second-order differential equation model its dynamics. However, if the damper has a magnetorheological fluid in the presence of a magnetic field then the fluid shows viscoelastic properties. Hence the mathematical model that best reflects the dynamics of this system is a fractional order differential equation. Naturally, the Mittag-Leffler function appears as analytical solution. Accordingly we present here the mathematical modeling of the mass-spring-magnetorheological damper system. The main result of our investigation is to show how the fractional order γ changes when the viscosity damping coefficient β changes, this was found when varying current intensity in the range of 0.2 to 2 Amperes. A Helmholtz coil is used to produce the magnetic field. We consider that this document has a high pedagogical value in connecting the fractional calculation to mechanical vibrations and can be used as a starting point for a more advanced treatment of \textit{fractional mechanical oscillations}

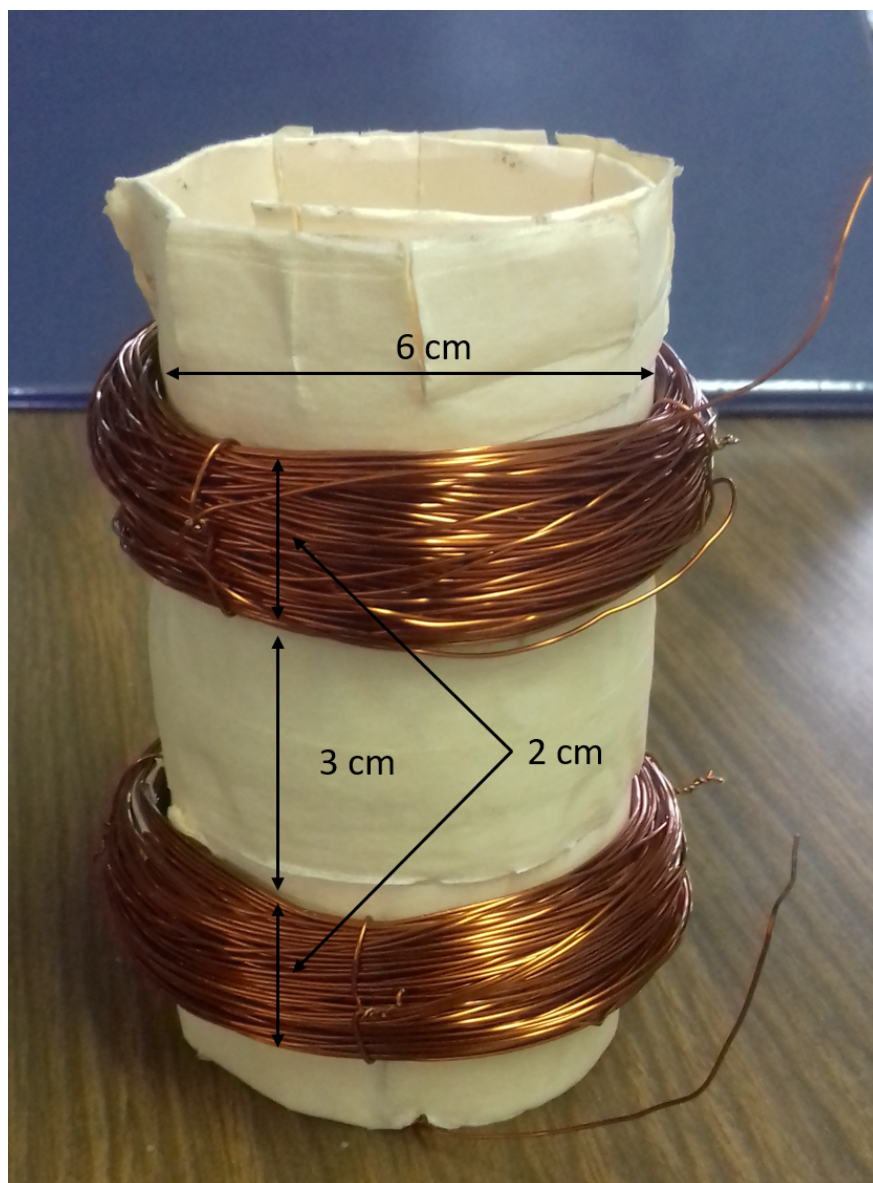
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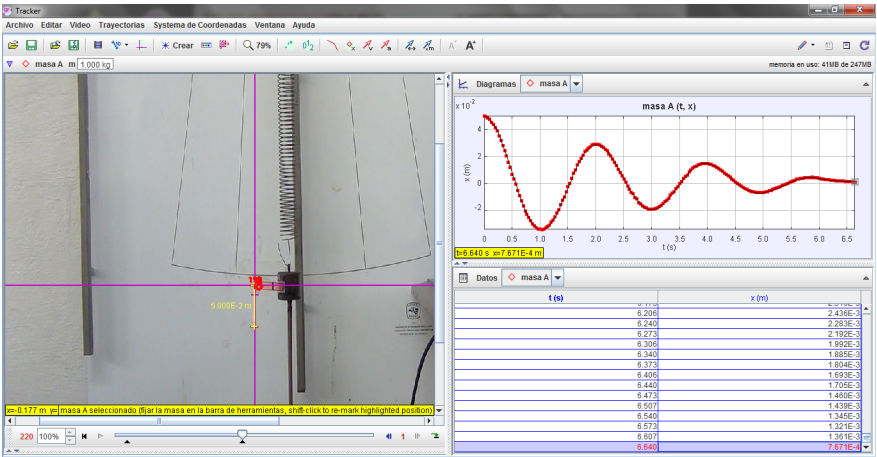
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