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Passive Mechanical Control

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The force-current and force-voltage analogies between mechanical and electrical networks are basic and very well-known. What is also well-known, but not always emphasised, is that the mass element fails to be a true network dual of the spring. This is due simply to the fact that Newton's Second Law relates the acceleration of the mass to a fixed point in an inertial frame, which in network terms means that one "terminal" of the mass is grounded. Such a restriction does not apply to the spring or damper, or to any of the three basic electrical elements. This fact has important consequences for network synthesis. Standard realisation procedures of passive electrical circuit theory show that any passive electrical impedance is positive real, and that any positive real rational function may be realised as the driving-point impedance of a network comprising resistors, capacitors and inductors only. There is a clear problem in translating this result over to mechanical networks if a given realisation contains a capacitor which has neither terminal connected to ground. A further drawback arises with the use of the mass element as the dual of the spring for the purpose of synthesis. Namely, it may be important to assume that the mechanical device associated with the "black-box impedance" to be designed has negligible mass compared to other masses in the system. Clearly this is unreasonable if (possibly) large masses may be required for its realisation. The purpose of this talk is to describe a recently introduced mechanical circuit element called the "inerter", which is capable of simple physical realisation, which can overcome these difficulties, and to discuss practical and theoretical consequences. Possible applications in vehicle suspensions and motorcycle stability will be described.

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Venue: Room H8, Control Systems Centre, Sackville Street Building,
University of Manchester

Free Admission - All Welcome

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