



Wolfson Department of Chemical Engineering Seminar

Monday, October 31st, 2022 at 13:30

Room 6

**Beyond Willis Materials:
Trianisotropy and the Electromomentum Effect**

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By developing and applying a homogenization scheme for elastodynamics, Willis discovered that the momentum of composite materials is macroscopically coupled with their strain. This coupling is captured by the now-termed Willis tensor, which not only enlarges the design space of metamaterials, but is also necessary for obtaining a meaningful effective description that respects basic physical laws. In this talk, I will show how additional tensors of Willis type emerge by generalizing the homogenization theory of Willis to thermoelastic-, piezomagnetic- or piezoelectric media. As a result, the obtained effective constitutive equations have a tri-anisotropic form. I will provide examples for piezoelectric media that exhibit an effective electromomentum coupling. I will show that this coupling is necessary for describing the effective properties of piezoelectric media using a homogenized description that respects reciprocity and energy conservation. Finally, I will demonstrate how this coupling can be used to realize a device that actively control the phase of elastic waves.