Deformation and flow of soft matter: what can we learn from ultrasound?

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Ultrasound is commonly used in medicine both at low intensity for diagnosis (echography) and at high intensity for therapy (lithotripsy or tumour treatment). The goal of this talk is to show that these two sides of ultrasound may also provide key fundamental insights into the mechanical behaviour of soft condensed matter.

First, we have developed an ultrafast ultrasonic imaging setup that provides access to the local deformation and velocity fields in complex fluids and soft solids under simple shear. This technique will be illustrated on various examples, including shear-banding and elastic instabilities in surfactant solutions,\(^1\) fracture in protein gels\(^2\) and delayed yielding in colloidal gels\(^3\).

Second, I will show that ultrasound can also be used in the high-power regime to interact with the structure of a soft material. Indeed, it is well known that ultrasound generates acoustic radiation forces when impacting on a solid boundary. We build upon this property to (i) fluidise locally a wet granular packing\(^4\) and (ii) study the effect of low-frequency ultrasound on the viscoelastic behaviour of a colloidal gel.

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