# Evolution of stress/displacement fields and contact area of elastomer spheres during oblique landing

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**Abstract**

**Evolution of stress/displacement fields and contact area of elastomer spheres during oblique landing**
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Under increasing shear, the contact between a rough elastomer and a rigid surface, for example in the case of a contact between a tire and a road surface, may undergo significant changes in terms of morphology of the micro-contacts due to the presence of wear (1). In this context, our research have been motivated by the observation made on these worn contact which are governed by heterogeneous wear traces (2) that may come from heterogeneous stress fields.

To better understand the initiation of wear, in this study, our aim is to analyze the contact stress and displacement state of a sphere made of elastomer during a representative kinematic for a rolling system: the oblique landing. These analyses are performed by measuring not only the classical evolution of macroscopic normal and tangential forces but also that of the true contact area and interfacial stress and displacement fields.

To do so, we perform a single normal loading/unloading cycle during a continuous shearing motion representative of one tire revolution in a new generation opto-mechanical device recently developed in our laboratory (4). The latter enables rich contact loading through five simultaneous and independent degrees of freedom with simultaneous high-resolution monitoring of all three forces and three moments at the contact interface. It also enables high-resolution in-situ visualization of the contact area, giving access to in-operando, measurements in the real contact area of the stress/displacement fields through advanced image analysis techniques (5).

This experimental procedure makes it possible to study the effect of several characteristic parameters, such as the ratio between "landing" and sliding speed or the maximal normal force. At first, we performed preliminary tests on unworn spheres of uncharged elastomer (PDMS) seeded with markers to monitor the evolution of contact area and interfacial stress

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and displacement field via image analysis. Then, we compare our experimental measurements with the prediction of a new analytical models already existing (3). Subsequent tests on pristine tire-type rubber enabled us to extend our comprehension to more realistic rubber materials and to make the link between wear pattern (2) and interfacial stress/strain fields.

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