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## Studies of stiction between MEMS microgear teeth by multilevel hierarchical models

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Tooth surface of a silicon microgear MEMS (Micro Electro Mechanical Systems) working in the vacuum is modelled by a hierarchical structure of multiple blocks located at different levels. The level of each block is defined by the gap between tooth surfaces at each particular instance. The tooth block roughness is modelled at two scales specified by character of interactions: Atomic scale; where chemical interactions occur at nanoscale; where van der Waals interactions are significant. There was no plastic deformation of the tooth surface asperities due to their size and the Polonsky-Keer effect. Friction force and the coefficient of friction were calculated using the total energy dissipated during contact between tooth surfaces. The adhesion forces act within the so-called "Maugis adhesive layer", and the force of adhesion is assumed to be equal to the pull-off force for a flat asperity. The numerical simulations show that a high probability contact between clean surfaces in a vacuum environment leads to stiction because the maximum force produced by the MEMS is less than the force of surface's tangential interactions. To avoid failure of the device of the tooth surfaces, it is suggested to functionalize the tooth surfaces by non-sticking monolayers because the stiction is mainly due to the so-called "cold welding" of clean crystalline materials. The numerical simulations showed that until the functionalizing monolayer is not worn away, the probability of stiction between the functionalized MEMS microgear teeth was greatly reduced.

### Biography

Nabeel Almuramady is a PhD student at Cardiff University, and has completed his MSc from Al-Nahrain University in 2007.

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