DESCRIPTION FOR THE GENERAL PUBLIC

This project seeks financial support to conduct a programme of fundamental research that will underpin the development and subsequent deployment of contactless conveying technology to transport light objects. This will be a major development for conveying product in manufacturing processes helping to improve product diversity, reduce waste and reduce energy consumption.

Behind this project is a ground-breaking idea of utilising the Poisson's ratio contraction phenomenon in contactless conveying of light objects. There are some preliminary results generated by one of the investigators [1] indicating that the novel approach to generate localized formation of a fluctuating dimple on a plane surface due to the Poisson's effect in order to induce a squeeze-film mechanism is feasible. This single dimple oscillates cyclically due to surface-mounted PZT actuators resulting in a few Newtons of lifting force sufficient to levitate light objects. Whilst the squeeze-film mechanism is a well-known phenomenon, creating it with a dimple that exploits the Poisson effect is novel and there is no literature on a multi-dimple array or using a multi-dimple array to generate squeeze-film levitation within novel handling and transfer systems. Conveying items of the order of 10-500g mass by this means represents a very large application field.

The primary scientific aim of the project is to investigate the principles governing the creation of a levitation force resulting from the interaction between Poisson's ratio contraction and the fluid (air) pressure induced by the fluctuation of the dimple (dimples) generated by the PZTs action. The application goal of the project is a novel contactless means of conveying objects along a production line using a new multi-dimple array squeeze-film technology developed from the single-dimple piezoelectric-plate. This technology will be more compact than currently used conveying technologies, enabling integration within a wide range of manufacturing systems, and providing the potential for new intelligent conveying lines. To the best of our knowledge, informed by the literature, the proposed project is undoubtedly novel with relevance to a large range of applications. Moving from single-dimple to a multi-dimple array smart plate constituting a critical and repeated element in a conveying line will present a significant challenge in terms of analytical modelling, complex actuation, optimisation of the plate's geometry and material, behaviour of the plate, and squeeze-film effectiveness.

[1] Stolarski, T.A., Self-lifting contacts - From Physical Fundamentals to Practical Applications, Proc. IMechE, part C: J. Mech. Eng. Sci., 220, p. 1211-1218, 2006.