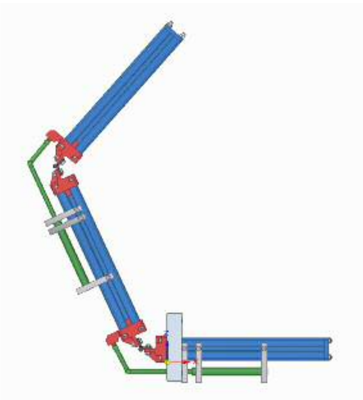
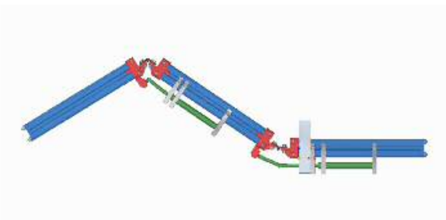
The Centre for
Power Transmission
and Motion Control

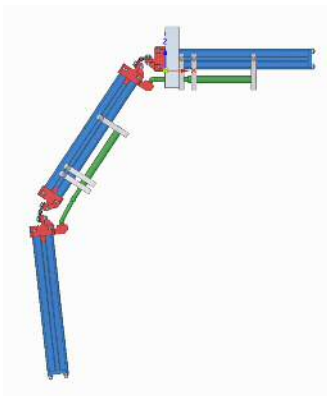
UNIVERSITY OF BATH

Research Project

HYPER-ACTUATED FLEXURE-LINK STRUCTURES FOR HIGH PERFOMANCE BEARING-FREE SERVO MECHANISMS







Motivation

Conventional mechanisms used in robotics and automated machinery have joints comprising bearing parts that collide, roll and slide against each other. The associated interaction forces affect the small scale motion, limiting the achievable accuracy when the motion is controlled automatically using actuation. Therefore the quality and efficiency of industrial processes are negatively impacted, including assembly and inspection of manufactured products.

Objective

Replacing the bearing with compact deformable structures acting as pseudo-joints, results in the small scale motion behaviour becoming more predictable and precise. However, flexible joints introduce an additional way in which a mechanism can move and vibrate. These motions must in turn be regulated through suitable actuation and control schemes, not only for precise positioning but also during rapid large-scale configuration changes, without causing unwanted oscillations or instabilities.

Current work

Test rigs have been designed for actuated flexure-jointed mechanisms, with single and double jointed mechanisms identified, including important consideration on how to apply the actuation forces to the mechanism structure. Corresponding mathematical models have been derived for large deformation flexure-joint mechanisms to be used in dynamic analysis, simulation and control procedures.

Future work

A controller design methodology will be developed, taking explicit account of the parasitic dynamics associated with the additional degrees of freedom. Experimental investigations of the test rig will be used to verify results gained from theoretical investigations, including the model accuracy and control effectiveness. Onwards research will include modelling and design of pseudo structures combining multiple crossed flexures that approximates single-degree-of-freedom revolute joint.

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