東京大学グローバルCOEプログラム　機械システム・イノベーション国際拠点

東京大学 THE UNIVERSITY OF TOKYO

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SPACE TETHERS and SPACE WEBS 1996-2011

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日時：2011年1月18日（火）16:30−18:00
会場：東京大学工学部2号館　3F　231号講義室

要旨

This lecture will discuss research carried out on space tethers and webs at the Universities of Edinburgh and Glasgow since 1996 to the present day and will attempt to place this work in the wider research context of the lecturer's career since 1981. Space tethers are long lines which can be used to connect two vehicles together in space for the purpose of momentum exchange between them and subsequent propulsion based on this and the prevailing orbital mechanics. Electrodynamic tethers offer the additional benefit of the dynamo effect obtained as a conductively cored tether cuts the geomagnetic field. This can be used both for propulsion and retardation. The lecture will start by summarising tether missions to date, beginning with Gemini 11 in 1966 and running through to the JAXA T-Rex mission of 2010, and will then consider some of the fundamental mechanics of momentum exchange tethers in Low Earth Orbit. The work on motorised momentum exchange tethers which was initiated by the lecturer at Edinburgh University in 1996 and then transferred to Glasgow University in 1998 is then summarised, and it is shown that three dimensional rigid-body models give rise to extremely complicated analytical models which in turn suggest a wide range of the most complex dynamical responses. The objective of a motorised momentum exchange tether in LEO is to achieve stable monotonic spin, and some results for this condition are given. It is also shown that tether strength estimates are of paramount importance and that such considerations can lead to interesting conjectures for missions involving 'staged' tethers which work co-operatively in pairs. Some terrestrial testing of a scale model motorised tether on ice is summarised and a study in which product designers were involved in developing more pragmatic solutions to payloads and capture/release mechanisms will be mentioned. The second part of the lecture deals with a conceptual extension of the tether to a two dimensional web, and a modelling paradigm for this is briefly summarised with a triangular web used as a basis for stability investigations. The lecture concludes with a proposal for inertial parametric excitation of a tether (or web) payload with a view to using this for bifurcation control. Early results indicate that even on the largest scale this could be realised with advantage, so that edge-of-bifurcation behaviour can be manipulated in a useful manner.

主催：　東京大学グローバルCOEプログラム「機械システム・イノベーション国際拠点」
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