Active washer for smart mechanical linkage

Christian Belly*, Adrien Guignabert, Aurélien Riquer, Gaël Chevallier† and Nicolas Peyret∞

* Cedrat Technologies
59 Chemin du Vieux Chêne 38246 Meylan Cedex, France
e-mail: {christian.belly} {adrien.guignabert} {aurelien.riquer}@cedrat-tec.com, web page: http://www.cedrat-technologies.com

† FEMTO-ST Institute, Applied Mechanics Dpt.
Université de Bourgogne Franche-Comté 25000 Besançon, France
Email: gael.chevallier@univ-fcomte.fr

∞ Laboratoire QUARTZ - SUPMECA – EA7393
3 rue Fernand Hainaut 93407 Saint-Ouen Cedex – France
Email: nicolas.peyret@supmeca.fr

ABSTRACT

Control of the tightening tension in critical bolted connections (rotor - blade or undercarriage - hub - wheel links, gearbox, motor group ...) is a niche market but is a real need for maintenance, which essentially consists in ensuring that the minimum torque value is always present in the assembly. Without this maintenance, carried out at regular intervals, the risks are significant for structures (fatigue, corrosion and crack occurrence). For example, maintenance operations for torque verification on a helicopter requires up to sixty hours every 1000 flight hours (400 concerned linkages). Moreover, several theoretical works have been performed in order to improve the vibration damping by semi-active control of the tightening load, [3-5].

Uncertainties and dynamic problems of bolted joints are widely treated in the literature [1]. Farther than detecting and monitoring the screw tension [2], the present paper proposes to counteract the preload loose using active components placed either under screw head or nut. This active washer component allows targeting several techniques, such as:

- Keeping constant preload within bolted assembly and make it stable through time,
- Act on linkage damping of mechanical linkage due to dry friction and/or as a complement to damping elastomer,
- Low frequencies protocol for structural decoupling.

The paper is composed of four parts. Firstly, for helping the reader to identify awaited benefits, the interest of actively controlled bolted assembly tension is shown. Secondly, a configurations trade-off is detailed, allowing catching advantages and intrinsic limitations of several concepts. Thirdly, experimental results are given on a single active washer and also on a lab user case, in order to compare with uncontrolled behaviour. Different techniques as described previously are considered in this experimental part. Finally, application fields and potentialities are pointed out introducing real user cases.

REFERENCES