

## Semi-Active Interface (SAI) Technique for Adaptive Impact Absorption (AIA)

D. Wiącek<sup>1</sup>, K. Sekuła<sup>1</sup>, J. Holnicki-Szulc<sup>2</sup>, L. Knap<sup>3</sup>

<sup>1</sup> Adaptronica sp. z o. o. Łomianki, Poland

e-mail: dwiac@adaptronica.pl, ksekula@adaptronica.pl

<sup>2</sup> Institute of Fundamental Technological Research, Polish Academy of Sciences, Warsaw, Poland  
e-mail: holnicki@ippt.pan.pl

<sup>3</sup> Faculty of Automotive and Construction Machinery Engineering, Warsaw University of Technology, Warsaw, Poland  
e-mail: Lech.Knap@pw.edu.pl

**KEYWORDS:** *Impact Absorption, Energy dissipation, Friction damper.*

### ABSTRACT

The problem of safe, impact loads absorption is present in a wide class of applications, and particularly where direction of the object's movement is well-defined, for example: precise docking systems, rail car buffers or landing gear shock absorbers. In those applications the objective is to absorb gradually impact energy, minimizing the deceleration peak. For safety reasons, the class of drop-caps (eg. in delivery business) or bigger airdrops from airplanes or from stratospheric airships (space debris) becomes a challenge for next decades. However, knowing the dropping mass and estimating the touchdown velocity, our SAI shock-absorbers (cf. [1]) made of multi-layered, "delaminable" panels, can be adapted to the expected impact. Therefore, let us concentrate on the SAI concept based on the following steps:

- design a multi-layer structure capable of semi-active "delamination" control along the contact infrastructure (slipping lines).
- apply an actuator realizing the on/off type of semi-active control for slipping lines' activation, playing the role of structural clutch (cf. the actuator in the so-called PAR vibration suppression technique, [2-3]),
- apply various characteristics for the contact interfaces (friction coefficient),
- apply various control strategies for the slipping lines activation (and releasing of the pre-stress effect), depend on the case study and identified on-line impact parameters.

The effectiveness of the proposed, adaptive approach to impact absorption (so-called Depress Dampers) will be compared versus traditional shock-absorbers, based on passive honeycomb panels (cf. also adaptive pneumatic shock-absorber concept).

**ACKNOWLEDGEMENT:** The presented results are based on research outcomes from the B+R projects supported by NCBR.PL [4-5].

### REFERENCES

- [1] A.Orłowska, L.Knap, J. Holnicki, „Semi-Active Interface (SAI) Technique for Suppression of Impact Born Vibrations”, 7<sup>th</sup> *European Conference on Structural Control*.
- [2] A.Mroz, J.Biczuk, J.Holnicki, “Sterowalne sprzęgło konstrukcyjne oraz jego zastosowanie”, Patent PL 230890
- [3] A.Mroz, A.Orłowska, J.Holnicki, “Semi-active damping of vibration. Prestress Accumulation-Release strategy development”, *Shock and Vibration*, 17:123-136, 2010.
- [4] COMPRESS – “Light composite aero-structures based on new manufacturing techniques including prestress”, POIR.01.02.00-00-0027/15,
- [5] Tango4- „Adaptive aerostats reinforced by supporting structures SDT (Self Deployable Tensegrity) for multi-thematic Earth observation (Aero-SDT)” (NCBR, PL)