EPFL-TTO

EPFL Innovation Park J
CH-1015 Lausanne
Switzerland
+41 21 693 70 23
http://tto.epfl.ch/

Research Contact

Simon Henein
+41 21 695 43 34
simon.henein@epfl.ch

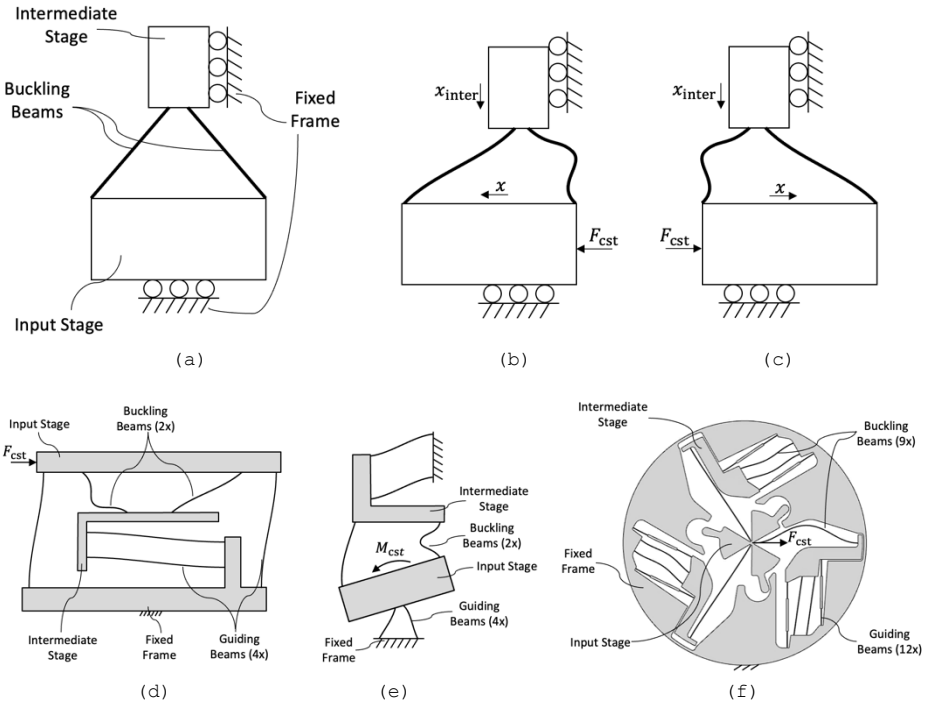
TTO Contact

Ghislain Singla
+41 21 693 54 77
ghislain.singla@epfl.ch

Licensing Opportunity

TTO – Technology Transfer Office

Multi-DOF Bi-Directional Constant-Force Flexure Mechanisms



New mechanisms with bi-directional constant-force functionality: (a-c) Constant-force linear stage (1-DOF) in neutral and deflected positions. (d) Flexure implementation of mechanism a. (e) Flexure pivot with constant torque. (f) XY-stage (2-DOF) with constant radial elastic restoring force.

Ref. Nr

6.2807

Keywords

Constant-force mechanisms, Force-limitation, Zero-stiffness, Latching mechanisms, Flexures

Intellectual Property

EP26162690.7

Publications

EPFL PhD Thesis n°11844, L.Tissot-Daguette, 2026

Date

9.9.2026

Description

Along their degrees of freedom, flexure mechanisms usually have a positive stiffness obeying Hooke's Law (i.e., their elastic restoring forces or torques are proportional to their displacements, whereas specific applications (see below) require an elastic restoring force or torque that is constant. The present invention provides this constant-force functionality: it consists in a family of novel mechanisms exhibiting a bi-directional constant elastic restoring force thanks to the use of embedded buckling beams. Such mechanisms have a ***high stiffness*** at the direct vicinity of their neutral position (as the buckling beam(s) are in a stiff pre-buckled state), which provide a ***locking function***, and they have a ***near-zero stiffness*** along their entire motion range away from the neutral position (as the buckling beam(s) are in a post-buckled state), which provides the ***constant force function***.

The patent covers linear and angular 1-DOF bi-directional constant-force stages. They constitute building blocks that can be kinematically arranged in series or in parallel to design bi-directional multi-DOF mechanisms.

Advantages

- Flexure mechanism with embedded locking function at the neutral position (prevents vibrations when the mechanism is not actuated)
- Constant force function over the full stroke, offering force limiting safety, reliable passive force control and the possibility for gravity compensation.

Applications

- Aerospace and astrophysics: Latching mechanisms.
- Robotic end effectors: passive control of constant-forces for repeatable operations and measurements and locking function during rapid motion.
- Surgical tools: Force-limiting tools.
- Horology: Bi-directional constant-force escapements for mechanical time bases.