CASE STUDY

ETH zürich

ZSR
ZURICH SOFT ROBOTICS

ZURICH SOFT ROBOTICS – DYNAMIC BUILDING FACADES

Problem – Challenge

Dynamic building facades such as shades, mirrors or solar panels have fascinated architects again and again. Changing the visual perception of a building over time or even changing façade properties to improve energy efficiency and regulate daylighting can significantly improve a building's design and the comfort of it's occupants. However, previous implementations, engineered mostly for a single project application have struggled with long term operation, often suffering mechanical failure. Hard actuators are good at positioning and locking a configuration but are incapable of absorbing repeated mechanical shocks.

Solution

The combination of a hard actuator with a soft actuator improves the performance. Soft actuators excel in absorbing mechanical shocks and damping of vibrations. The combination of both actuator types makes dynamic elements robust and reliable.

More precisely, a hard pivotal joint is combined with a soft pneumatic actuator. The joint prevents motion along and rotation around the longitudinal axis. At the same time a pneumatic control system adjusts the pressure in the surrounding pneumatic chambers. A difference in the pressure between chambers induces bending.

Founded in 2022, the ETH spin-off Zurich Soft Robotics uses this technology for Solskin, which is a climate-adaptive building skin. The actuators move lightweight PV panels and are mounted as prefabricated units onto building façades. Solskin stands for efficient solar energy production and intelligent shading. It significantly reduces the operational energy consumption of buildings and prevents overheating in the summer.

In 2025, the spin-off will install 1'300 m² of Solskin on its first flagship project for KELLER Druckmesstechnik AG in Winterthur. The spin-off will also implement intelligent AI algorithms for energy and comfort optimization within an Innosuisse project with ETH Zurich.

Hard-soft actuator with joints for precision movements and pneumatic chambers for adjusting the stiffness and effectuating bending motions

Proof-of-concept with a demonstrator set-up at NEST, Empa. Image: Roman Keller