When two books are interleaved page by page, pulling them apart becomes unexpectedly difficult. The resistance comes from friction across many thin layers. This phenomenon, known as layer jamming, can be harnessed as a simple and effective mechanism for variable stiffness.

In this project, which was showcased in Japan at IEEE International Conference on Robotics and Automation (Robosoft), we applied layer jamming to wearable robotics. By stacking thin acrylic sheets between custom-made pneumatic actuators, we create structures that transition between flexible and rigid states with minimal actuation. In the unpressurized state, the layers move freely, allowing bending and rotation. When pressure is applied, friction between the layers increases, restricting motion and effectively locking the structure in place.

While this approach has previously been studied in the field of soft robotics, previous methods used vacuum to change the state. The main contribution of this work is the development of a system that works with positive pressure, increasing the force output, expanding the design space, and improving the reliability of the device.

A key advantage of this approach is its tunability. Stiffness can be adjusted in two ways, through on-board control by varying internal pressure in real time, and through off-board configuration by changing the number of layers. This dual mechanism allows both dynamic adjustment during use and simple customization beforehand, similar to how you would adjust weights on a rack.

We demonstrate the concept with two wearable prototypes, an arm exoskeleton and a neck support device. Both systems are lightweight and portable, making them suitable for applications such as assisting manual handling tasks in industrial settings or supporting rehabilitation. The approach may also be useful in environments such as microgravity, where conventional weight-based training cannot be done.

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- **Michael Adlerstein**