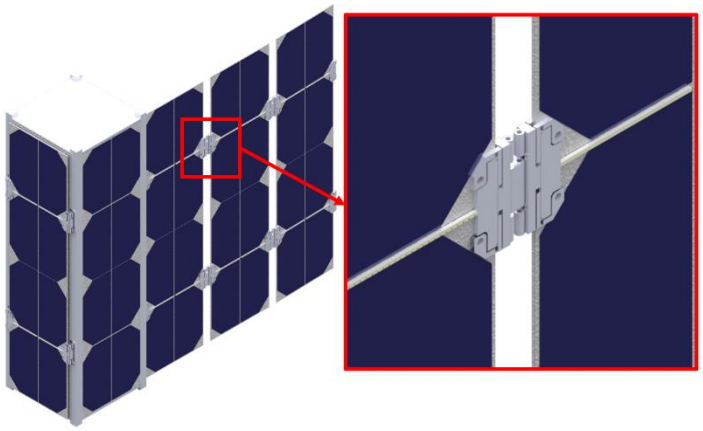
samara
aerospace

SUPERIOR ATTITUDE CONTROL

Our goal is to revolutionize spacecraft attitude control by eliminating redundant mass and volume and greatly increasing pointing accuracy, all at a fraction of the cost of traditional systems. Samara's "Multifunctional Structures for Attitude Control" (MSAC) technology was invented at the University of Illinois at Urbana Champaign. Actuators are embedded in a spacecraft's deployable panels and move them at low amplitudes and high frequencies. The panel is extended, rotated, retracted, and rotated back for a net gain in spacecraft angle. This system can store momentum, perform large slew maneuvers, and achieve state-of-the-art jitter control, all using existing mass in the deployable panels.



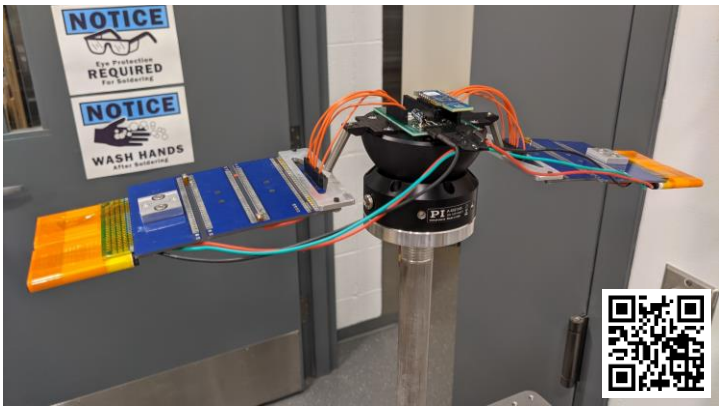
3U Hinge-MSAC design concept. Piezoelectric actuators are embedded in offset hinges to allow for 3-axis control.

RELEVANCE

Many next-generation deep space missions require fine pointing for imaging and high data rate communications. The MSAC technology provides extremely high pointing accuracy and stability. Jitter produced by other spacecraft systems, such as reaction wheels or fluid pumps, is actively damped by producing identical movements with a 180-degree phase offset. Jitter control and momentum storage are achieved using the pre-existing mass of the spacecraft solar panels, resulting in overall mass and volume savings. Since MSAC uses distributed actuators, it is more reliable than conventional attitude control systems. Current prototypes focus on the CubeSat form factor, but MSAC is applicable to all spacecraft sizes; control authority increases with larger panel size.

DEVELOPMENT

The performance of the MSAC system has been shown through extensive multi-body simulations and hardware-in-the-loop tests. Active jitter cancellation was demonstrated with a Strain Actuated Solar Array (SASA) lab demonstration. Three MSAC hardware systems have been developed to prove the momentum storage and large angle slewing capability. Samara Aerospace is targeting two flight opportunities, with a potential launch in 2025.



MSAC hardware-in-the-loop laboratory demonstration on an air bearing, https://youtu.be/19rFLK7Jy-o

MSAC vs. CONVENTIONAL SYSTEMS

MSAC has the potential to be significantly higher performance and lower mass and volume than conventional ACS systems. This table compares an MSAC system to conventional reaction wheel ACS for three spacecraft classes: 10 kg (optimized for volume), 100 kg (balanced optimization), and 1000 kg (optimized for power).

Spacecraft class		10 kg	100 kg	1000 kg
MSAC	Power [W]	2.4	2	1.24
	Mass [kg]	0.22	1	2
	Volume [cc]	≤ 50	250	2000
	Pointing Accuracy [μ rad]	38 – 0.002	183 – 0.003	27 – 0.000021
	Momentum storage [N.m.s]	0.002	10	60
	Peak torque [N.m]	2	15	20
Conventional ACS systems	Power [W]	4	40	140
	Mass [kg]	0.6	12.8	30
	Volume [cc]	300	8000	23,000
	Pointing Accuracy [μ rad]	122	184.5	0.012
	Momentum storage [N.m.s]	0.0015	4	20 – 50
	Peak torque [N.m]	0.0001	1	6

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