A paper discusses general problems in estimation and control of the states (positions, attitudes, and velocities) of spacecraft flying in formation, then addresses the particular formation-flying-control problem of synchronization of deadbands. The paper presents a deadband-synchronization algorithm for the case in which the spacecraft are equipped with pulse-width-modulated thrusters for maintaining their required states. The algorithm synchronizes thruster-firing times across all six degrees of freedom of all the spacecraft. The algorithm is scalable, inherently adapts to disturbances, and does not require knowledge of spacecraft masses and disturbance forces. In this algorithm, one degree of freedom of one spacecraft is designated the leader, and all other degrees of freedom of all spacecraft as followers. The Cassini adaptive optimum deadband drift controller is the subalgorithm for control in each degree of freedom, and the adaptation is run until each spacecraft achieves a specified drift period. The adaptation is critical because a different disturbance affects each different degree of freedom. Then the leader communicates its thruster-firing starting times to the followers. Then, for each follower, a deadband-synchronization subalgorithm determines the shift needed to synchronize its drift period with that of the leader.

This work was done by Daniel Scharf, Fred Hadlegh, and Bryan Kang of Caltech for NASA’s Jet Propulsion Laboratory. The software used in this innovation is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-43258.

### Adaptive Deadband Synchronization for a Spacecraft Formation

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