Improved Adaptive Control System Using Selectable Parameters

Simple adaptive control system design that augments existing control systems

Anthony J. Calise, Kilsoo Kim, and Tansel Yucelen from the School of Aerospace Engineering at Georgia Tech have developed simple adaptive control system design that augments existing control systems. This less complex adaptive system can control both minimum phase and non-minimum phase systems, including difficult-to-control aircraft longitudinal dynamics.

The inventors have employed a parameter-dependent Riccati equation approach to adaptive control. This approach assumes that a state observer (i.e., sensor) is employed in the nominal controller design. The observer design is modified and used instead of a reference model. This is combined with a novel adaptive weight law that ensures that estimated states follow both the reference model states and the true states so that errors are bounded, resulting in a more stable system.

Summary Bullets

- **Faster:** Requires less complexity in the code, enabling faster control response times
- **Smoother:** Improves control stabilization and tracking performance
- **Versatile:** Augments existing nonadaptive control systems without modifying the gains employed in those systems

Solution Advantages

- **Faster:** Requires less complexity in the code, enabling faster control response times
- **Smoother:** Improves control stabilization and tracking performance
- **Versatile:** Augments existing nonadaptive control systems without modifying the gains employed in those systems

Potential Commercial Applications

- Flight control of aircraft, missiles, drones, spacecraft
- Process controllers in industrial applications
- Engine control in automotive applications

Background and More Information

This technology was developed to provide a simpler and faster adaptive control system for use in a variety of uncertain systems—that is, those with fixed or varying parameters that are only approximately known. Examples of such systems include aircraft flight, vibrating systems, turbine engine dynamics, or combustion processes. Existing adaptive controllers estimate the status of the system based on sensed measurements. The adaptive controller then adapts to the feedback, thereby stabilizing the uncertain system. Many existing adaptive control systems rely on reference models of ideal system characteristics, but this can result in very complex control system software. In addition, incorporating adaptive controllers can mean replacing or overhauling existing control systems.

Inventors

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IP Status

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Publications

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