



Artificial Immune System-Based Approach For Air Combat Maneuvering

NASA has developed a tactical maneuvering system that uses an artificial immune system-based approach for selecting maneuver sequences for air combat. These maneuvers are composed of autopilot mode and target commands, which represent the low-level building blocks of the parameterized system. The resulting command sequences are sent to a tactical autopilot system, which has been enhanced with additional modes and an aggressiveness factor for enabling high performance maneuvers.

During air combat maneuvering, pilots use their knowledge and experience of maneuvering strategies and tactics to determine the best course of action. As a result, we try to capture these aspects using an artificial immune system approach. The biological immune system protects the body against intruders by recognizing and destroying harmful cells or molecules. It can be thought of as a robust adaptive system that is capable of dealing with an enormous variety of disturbances and uncertainties. Just as vaccinations train the biological immune system how to combat intruders, training sets are used to teach the maneuvering system how to respond to different enemy aircraft situations.

This technology is available for licensing from NASA's space program to benefit U.S. industry.

Technology Details

The Artificial Immune System (AIS) combines a priori knowledge with the adapting capabilities of a biological immune system to provide a powerful alternative to currently available techniques for pattern recognition, learning, and optimization. Immunology is the science of built-in defense mechanisms that are present in all living beings to protect against external attacks. A biological immune system can be thought of as a robust, adaptive system that is capable of dealing with an enormous variety of disturbances and uncertainties. The AIS uses a finite number of discrete "building blocks" to achieve this adaptiveness. These building blocks can be thought of as pieces of a puzzle, which must be put together in a specific way to neutralize, remove, or destroy each unique disturbance the system encounters.

Another critical aspect of the immune system is that it can remember how previous encounters were successfully defeated. As a result, it can respond faster to similar situations in the future. This is especially critical for Air Combat Maneuvering (ACM), where split-second decisions can mean the difference between successful and unsuccessful encounters. In terms of AIS, this is accomplished by establishing problem-to-solution mappings that can be further strengthened over time. Inoculations are performed using training sets to introduce the AIS to a variety of different intruder aircraft scenarios. This represents the equivalent of the training pilots received in order to make quick decisions under combat situations.

Patent

This technology is protected by a pending U.S. Non-Provisional Patent Application. (Reference No. ARC-15977-1)

Benefits

- Capable of high performance aerobatic maneuvers while maintaining the ability of flying under degraded mode
- Ability to select multiple maneuvers and construct them into a sequence in order to achieve a tactical objective
- Greatest benefit is the tactical autopilot's deterministic behavior it provides



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