Supporting Coalition Operations of Target Movements Exploration through evolutionary Computation and 3-d Visualisation

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Increased responsibilities of today's military coalitions carry a greater need for imagery support. However, as the number of collected images continues to grow, their exploitation needs outpace our resources to analyze them and becomes a bottleneck for the intelligence community. This situation is especially apparent for Ground Moving Target Indicator (GMTI) based imagery data collections. GMTI supports such exploitation processes as target tracking and estimation of target location, identity and activity. The exploitation of information in GMTI could be further enhanced by incorporation of target movement prediction methods. Such methods can potentially provide important information on the enemy's intent that is not currently adequately exploited. However, from a computational point of view, the problem of predicting target movements is very complex. This is attributed to the fact that such prediction would require modeling of various cognitive processes (e.g., group behaviors) that are generally difficult to define or formulate abstractly.

Current tools provide some level of analysis (e.g., flow, sources and sinks, event formation). They apply advanced algorithms for pattern analysis (motion, behavioral), geo-registration, multi-sensor feature correlation (multiple platform tracking), and resource allocation and scheduling. However, as they are mainly processing GMTI tracked data, they lack the capability for prediction of movements, i.e., generating untracked future target flow traffic.

The paper describes a Genetic Evolution of Movement (GEM) approach for inferring opponents' strategic movements and for displaying such predicted movements in an interactive 3D Visualization Space. The prediction approach generates new movements based on past behaviors and application of inheritance mechanisms. Specifically, the approach applies Genetic Algorithms (GAs) learning techniques to evolve new individuals in the population of movements in order to converge the evolution process toward optimal (most probable) movements.