Greedy algorithms best for multiple targets

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What algorithms should an air defense system work with? Particle swarm algorithms if there are ten targets to be hit. If there are more than ten targets, greedy algorithms work best. These findings are presented by researcher Fredrik Johansson at the Informatics Research Centre, University of Skovde, in Sweden.

So-called TEWA systems (Threat Evaluation & Weapon Allocation) are used to protect strategic targets from enemy attacks, such as an airfield that needs to be protected from incoming missiles.

The systems discover threats, evaluates the threats, and aims the defender's weapons system to be able to knock out the threat. The final decision to fire is then made by an operator.

Researcher Fredrik Johansson at the Informatics Research Centre, University of Skövde, in Sweden, recently defended his doctoral thesis on algorithms for TEWA systems.

"In the existing research literature there are proposals regarding what algorithms may be appropriate to use in TEWA systems. I have developed methods to test which algorithms work best in practice," explains Fredrik Johansson.

Fredrik Johansson's study shows that what determines the choice of algorithm is the number of weapons in the TEWA system and the number of targets the system has to deal with.

"So-called particle swarm algorithms are effective if it's a matter of up to about ten targets and ten weapons. If the TEWA system needs to keep track of more targets and weapons, we should use what are called greedy algorithms instead," says Fredrik Johansson.

A greedy algorithm – simply put – is fast but not perfect. The algorithm works under broad guidelines and does not test all the alternatives necessary to obtain an optimal solution. The fact that it doesn't need to test certain solutions makes it a rapid algorithm, a property that is crucial in a TEWA system.

"You can't let it take many seconds between the system discovering a threat and the operator deciding whether or not to fire," says Fredrik Johansson.

In previous studies TEWA systems have nearly always been treated as two parts: threat evaluation and weapon allocation separately. Fredrik Johansson's study is one of the first to see the system as a unit. But to claim that you are the first to study something may be difficult when it comes to TEWA systems.

"Those conducting research in this field don't always know what knowledge there is beneath the surface. There's probably some research about TEWA systems that is secret and not available to us ordinary researchers," concludes Fredrik Johansson.

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