Preface

Last decade has seen a paradigmatic change in the operational processes of modern armies' aerial forces, as designers and commanders have been gradually shifting their focus towards unmanned aerial vehicles (UAVs). Indeed, over 50% of the planes in the USA today are unmanned, with this trend expected to further increase, and be adopted by additional Western armies in the coming years. This has been the case in visual intelligent (VISINT), and recently also in tactical signal intelligence (SIGINT), which is traditionally in charge of 80% of the information gathered by the intelligence corps.

Therefore, as the use of Drones as an integral component on ongoing intelligence gathering in wartime, as well as during the "battle within the wars" increases, so grows the importance of the need to base this use on an efficient infrastructure. In other words, an innovative small-scale dedicated UAV squadron (namely, a Drones Swarm), designed for special missions, may function perfectly with high redundancy and inefficient use of its resources, but a regular large-scale information gathering that is based on unmanned vehicles operating in swarms cannot. Furthermore, the lack of an efficient infrastructure that assumes control of the low-level resource utilization tasks means that these tasks must ultimately be taken care of by the human operators (as is being done today)—dramatically reducing the number of tasks these can engage, increasing the time it takes them to do so, as well as the overall cost of this process, and ultimately significantly limiting the vehicles' operational potential.

As the complexity of the problem increases, so does the impact of optimizing capabilities on the overall resources required in order to guarantee a pre-defined level of performance. In other words, a successful use of large-scale swarms of UAVs as a combat and intelligence gathering tool necessitates the development of an efficient mechanism for optimization of their utilization, specifically in the design and maintenance of their patrolling routes.

This book offers a comprehensive analysis of the theory and tools needed for the development of an efficient and robust infrastructure for the design of collaborative patrolling UAV swarms, focusing on its applications for tactic intelligence Drones. The systems under discussion enable flocks of semi-autonomous vehicles to

perform an ongoing dynamic efficient patrolling and scanning of pre-defined "search region", in a robust and near-optimal way, in as fast time as possible, while guaranteeing detection of all targets that are located in that region. Theoretical limitations of such systems are discussed, as well as the trade-offs between the various economic and operational parameters of the system.

Cambridge, USA Yaniv Altshuler
Cambridge, USA Alex Pentland
Haifa, Israel Alfred M. Bruckstein

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Altshuler, Y.; Pentland, A.; Bruckstein, A.M.

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