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DETECTION QUALITY MEASURE IN SURVEILLANCE WIRELESS SENSOR NETWORKS

Abstract
The performance of a surveillance wireless sensor network is generally measured with its detection capability which is affected by various parameters such as the sensor count, the sensor range, the area width and the target mobility model. We assume that intruders prefer some favorite paths because of their geographical advantages and pass through them instead of following a random mobility model. These paths are generally in close vicinity of each other and they can be bounded in a region. In this thesis, we inspect the travelers' favorite region notions and propose some image processing tools to detect their location within a border area. Following this, we present a closed form of the detection probability as the detection quality measure in the existence of travelers' favorite paths. The detection probability is reduced to the geometric line intersection problem using bijection and the boundary conditions of intruder trajectories for the border area and the favorite regions are determined. The line intersection problem is solved using tools from the integral geometry and geometric probability. The effect of the favorable region on the detection quality under different conditions is calculated using probabilistic models. The accuracy of the proposed quality measure is validated by both analytical methods and simulation results. Furthermore, the importance of the intrusion model on the network performance is presented using realistic scenarios. It is shown that the existence of favorite paths has significant impact on the detection quality of the network. We extend our work to border areas with multiple favorite path regions and present a closed form of detection probability for such generic cases. We also inspect the effects of various system parameters such as the sensing model and application scenarios on the detection quality measure using both analytical tools and simulations. The proposed detection quality measure provides analytical tools to forecast the expected detection performance and to optimize the network according to the intruder mobility model.

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Defense Date: 03.07.2012