POSTER: The Development of Active Self-Preservation Policies for Ensuring the Cyber-Physical Security of Unattended, Car-Like, Mobile Sensor Nodes.

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***Abstract*— In recent years there has been a significant interest in the development of car-like mobile sensor nodes [1]. The Google Street View service and the CarTel Project [2] are two prime examples. Contemporary car-like mobile sensor nodes require that a human operator oversee their operation. The next evolution is to enable the deployment of mobile sensor node fleets that operate unattended for long periods of time with a minimum of supervision. In order to make this vision a reality, the cyber-physical security challenges surrounding unattended, car-like mobile sensor nodes must be addressed. Mobile sensor nodes are inherently cyber-physical systems in the sense that they possess tight interplay between their mechanical, electrical, computational, and information systems. As such, the security issues surrounding mobile sensor nodes will typically display a tight coupling between physical security and cyber security concerns. A mobile sensor node could be compromised in a variety of ways that would impact both cyber and physical security. In some situations, a mobile sensor node may be targeted for theft, and as a result, appropriate physical security measures should be taken to avoid this possibility. In the event that the mobile sensor node is physically stolen, cyber-security security challenges arise in the sense that data onboard the node or its network may be compromised, altered, or destroyed. Alternatively, breaches in cyber-security can lead to the breach of a mobile sensor node's physical security. For example, an attack mounted against the wireless communications between a mobile sensor node and its base-station can open a window of opportunity to physically steal or tamper with the node, with a reduced chance of detection.**

The focus of this work is to develop control policies to ensure the self-preservation of car-like mobile sensor nodes subject to precision immobilization technique (PIT maneuver) attacks. The PIT maneuver is a technique originally developed by law enforcement to bring high speed vehicular pursuits to an end in a quasi-safe manner. Fig 1. illustrates the execution of a PIT maneuver. It is easy to imagine that the PIT maneuver could be used by thieves to immobilize a car-like mobile sensor node for the purpose of stealing it and compromising its data. Previous work in this area has focused on developing strategies for mobile sensor nodes to both execute and resist the PIT maneuver using mobile sensor nodes. These strategies have been demonstrated in simulation, and are currently being field tested on board small-scale models. The next stage of this effort is to begin developing control policies to recover from, and counter the PIT maneuver. J-turn active recovery will be explored to help mobile sensor nodes recover from PIT maneuvers with a minimum disturbance to their escape route. The "reverse-PIT" maneuver will also be developed to enable a mobile sensor node to apply the PIT maneuver to hostile agents when no other means of escape is practical. This research will be explored using simulation as well as small-scale, car-like mobile sensor node models. The control policies developed in this and previous work will later be integrated into an intelligent framework dedicated to ensuring the cyber-physical security of car-like mobile sensor nodes.

Keywords-cyber-physical security; PIT Maneuver; self-preservation; mobile sensor node.

REFERENCES

[1] Thrun, S., "Toward Robotic Cars," Communications of the ACM, Vol 53, Issue 4, April 2010

[2] Hull, B., Bychkovsky, V., Chen, K., Goraczko, M., Miu, A., Shih, E., Zhang, Y., Balakrishnan, H., and Madden, S., "*CarTel: A Distributed Mobile Sensor Computing System*," in Proc. ACM SenSys, 2006.

Figure 1: The manual execution of the PIT maneuver on a car-like mobile sensor node.