

Attachment 1 – Research Topic Template

1. **Research Title:** Detection and Segmentation of Dynamic Human Signatures from Clustered LIDAR Streams

2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level**

Computer Science, Computer Engineering, Electrical Engineering (PhD level)

4. **Objectives:** Develop a theoretical framework and computer algorithm to autonomously sense the presence of human activities and segment out individual human signatures from streaming scenes of clustered LIDAR data.

5. **Description:** Recent developments in sensor technology bring the possibility of adding 3D sensors, such as flash LIDARs (Light Detection and Ranging), to autonomous robots and surveillance systems. Compared to 2D imagery, the extra depth dimension in 3D sensor outputs reduces the complications or distortions caused by lighting, texture, projection, and motion ambiguity. However, LIDAR scenes made of partial 3D point clouds of irregular human poses are difficult for a human analyst to discern and the streaming nature of persistent surveillance means extremely large amounts of data. This situation calls for autonomous machine agents in place of human analysts. One of the core functions a machine agent has to perform is to automatically separate out dynamic human signatures from the background and clusters of other irrelevant objects present at the scene.

Although there are many methods for 2D image segmentation (template matching, edge detection, surface modeling, clustering, graph partitions, probabilistic graphical model, etc.), their applicability, extensibility, and performance on LIDAR data are not well-investigated. A few existing LIDAR and range camera related studies are limited to planar surfaces or static scenes. A scene involving human activities is more challenging due to occlusions, either self or from other sources. This topic places an emphasis on segmenting human figures from temporal and spatial cues. The method needs to detect a person among other moving or static objects already present at the scene and extract a sequence of partial 3D point clouds registered to the same person. The datasets can be public domain real-world or synthetic LIDAR data, with varying scales and viewing angles including elevated ones. The research scope will be limited to several prototype human actions in a few typical urban and rural scenes, though good scalability is required. A performance comparison with other state-of-the-art methods is highly desirable.

6. **Research Classification/Restrictions:** The proposed project is unclassified and does not have ITAR restrictions.

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7. **Eligible Research Institutions:** Indicate to what organizations this topic should be provided



DAGSI (Wright State University, AFIT, Ohio State University, University of Dayton, Miami University, Ohio University, University of Cincinnati) NOTE: Topics submitted to DAGSI must be approved for public release. PA Approval # 88ABW-2014-2960, 711 HPW/XPO 17 June 2014



AFIT (only)



USAFA (only)

If you are submitting a topic for the USAFA, indicate if you are also interested in sponsoring a USAF Cadet in summer 2015 (Average cost for USAF Cadet for 33 days is \$5000)

Yes

No