UTC Project Information	
Project Title	Radar and LiDAR Fusion for Scaled Vehicle Sensing Test
University	Virginia Tech
Principal Investigator	Miguel Perez, Co-PI: Zac Doerzaph
PI Contact Information	mperez@vtti.vt.edu, work: 540-231-1537 zdoerzaph@vtti.vt.edu, work: 540-231-1046
Funding Source(s) and Amounts Provided (by each agency or organization)	SAFE-D (Federal): $42,049 non-Federal: $100,000
Total Project Cost	$142,049
Agency ID or Contract Number	Grant No: 69A3551747115 Project: VTTI-00-025
Start and End Dates	12/25/19/ - 7/31/20
Brief Description of Research Project	Fusion of LiDAR and radar data to augment radar object tracking in a scaled environment. The high spatial resolution sensor (LiDAR) can be used to, in conjunction with a radar data stream, create Synthetic Radar Data (SRD). The resultant data will support better Kalman filter vehicle tracking performance at small scale than other approaches.

Describe Implementation of Research Outcomes (or why not implemented)
 	
Place Any Photos Here
	Deliverables:
	• Final Report
	• Final Dataset and Metadata Uploaded to VTTI Dataverse
	  ○ Radar data at full scale
	  ▪ Use Continental radar and RTS to track a single vehicle in a full-scale environment
	  ○ Radar data from small scale environment
	  ▪ Use the “miniCube” (1/5 scale car) as a vehicle operating in a small-scale environment
	  ▪ Collect the radar data from these runs
	  ○ LiDAR data from small scale
	  ▪ Collect LiDAR data from the same runs at small scale
	• Project Closure Report
	EWD Activities
	• Target InternHUB involvement
	  ○ InternHUB students employed through VTTI and the industry partner will work directly on the development of the project as research team members

	○ Project involvement from undergraduate students advances their working knowledge in transportation engineering • Master's thesis written and defended based off this body of work • Develop learning modules ○ Incorporate the underlying mathematics behind Kalman Filtering, point cloud filtering, and object detection as well as information on the popular message passing protocols and algorithm frameworks used in some automotive industries as part of L2 automation • Exhibit at Falling Branch STEM night ○ Provide insight on the sensors, algorithms, and frameworks used in AVs to around 300 attendees • Exhibit at Virginia Tech Science Festival ○ Provide insight on the sensors, algorithms, and frameworks used in AVs to around 5,000 attendees T2 Plan • Leverage industry partners ○ Continental, a Tier 1 supplier who is providing matching funding, will be directly involved in the project and its outcomes ○ Technical expertise from Continental will be leveraged on the research team and the newly generated knowledge from the completion of the project appropriated into similar fields of interest within Continental's product development • Journal article submission ○ Targeting a competitive automotive or sensing journal • Conference paper presented ○ Develop presentation for automotive, transportation, or sensing conference
Impacts/Benefits of Implementation (actual, not anticipated)	The outcomes of this work are expected to allow for the improvement of scaled vehicle test-beds in the automotive engineering tool chain. Radar tracking solutions developed at full scale could then be more easily implemented into these test beds with only the addition of an off-the shelf LiDAR sensor. Better and more-reliable, non-virtual automated scaled test beds allow automotive and software engineers the chance to quickly, safely, and inexpensively challenge test systems under development. Quicker demonstrations and tests allow for intuitive identification of system failures and capabilities as well as an opportunity to explore varying sensor layouts and development. This will be particularly useful as the transportation field designs solutions for small package delivery robots.

Web Links • Reports • Project website	https://www.vtti.vt.edu/utc/safe-d/index.php/projects/radar-and-lidar-fusion-for-scaled-vehicle-sensing/