

# MARTI<sup>®</sup> Software



*Modular Perception, Localization and Navigation Software for Automated-Driving, Active Safety, and Unmanned Ground Vehicles*



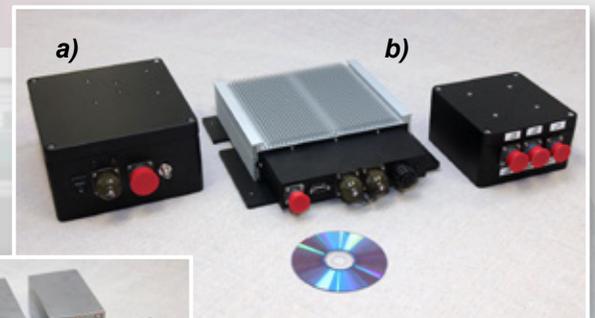
## *The MARTI Software*

SwRI<sup>®</sup> began development of the MARTI Software in 2006 to provide warning, mitigation, avoidance, and automation capabilities for passenger cars, commercial trucks, construction equipment, agriculture implements, and military ground vehicles. This system was first publically demonstrated on a Ford Explorer in 2008 on the streets of New York City. Since then, SwRI has refined the software, which currently runs in C++ on Linux and in the Robot Operating System (ROS). MARTI Subsystems include perception, localization, navigation, and cooperative behaviors. SwRI customers have leveraged parts of the MARTI Software in developing their intelligent vehicle solutions.

## *The MARTI Perception Subsystem*

Sensor agnostic near real-time perception algorithms that provide:

- Low-cost multi-spectral material classification at 12Hz for traversability determination.
- Generic-object identification, classification, tracking and prediction with high detection rates and low false positive rates (vulnerable road users, vehicles, work zone objects, etc.).
- 3D persistent world model that generates layered environment cost maps by fusing real-time sensor data in surface and voxel models.



*Sensor agnostic and distributable throughout any vehicle platform.  
a) localization b) perception*



## *The MARTI Localization Subsystem*

Algorithms that fuse disparate, low-cost proprioceptive and exteroceptive sensors in an extended kalman filter have been developed for:

- Relative localization with an observed mean error of <math><0.1\%</math> error/distance travelled with maximum error of 0.4% error/distance travelled without GPS over 40km.
- Absolute localization to convert observations into absolute global position to snap-to-map.
- A single IP67 package encompassing low cost, commercial-off-the-shelf hardware with interface flexibility.

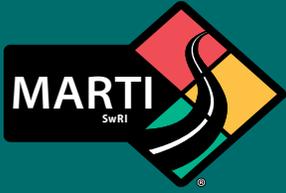


*Low-cost localization hardware, can use existing vehicle sensors*



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# MARTI<sup>®</sup> Software



*Modular, Scalable, and Extensible*



## *The MARTI Navigation Subsystem<sup>1</sup>*

Path planning and control algorithms are capable of interfacing with five different commercially available drive-by-wire systems (actuators). The MARTI Navigation Subsystem utilizes an A\* planner and utilizes Ethernet or CAN interfaces.

## *The MARTI Cooperative Subsystem*

Demonstrates higher level behaviors, such as platooning/convoy and cooperative sensor sharing whereby multiple manned and automated vehicles exchange data and work together to perform a higher level mission. Based on the NIST 4D/RCS behavior-based architecture, the MARTI software can be easily modified to realize new automated behaviors to customer requirements.

## *Engineering Technology Demonstrators*

SwRI has installed the MARTI software on eight ground vehicles to include commercial and military vehicles and a Class VIII Tractor Trailer. The MARTI software is proven platform-independent. SwRI has developed a Portable Engineering Technology Demonstrator to allow for the MARTI Perception and Localization Subsystems to be easily installed and moved between different actuated platforms. This system consists of low cost commercially available hardware. Based on customer performance specifications, specific hardware can be selected to achieve performance levels at the lowest cost possible.



*SwRI's portable engineering technology demonstrator for the MARTI software*

## *The MARTI<sup>®</sup>|XE Software (Export Edition)*

The MARTI|XE Software is the export version of the MARTI software. Once customer requirements are established, SwRI works with our customers to ensure appropriate export paperwork is in place to facilitate the export of the appropriate subsystems.

<sup>1</sup> Not included in MARTI|XE

### **For more information:**

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