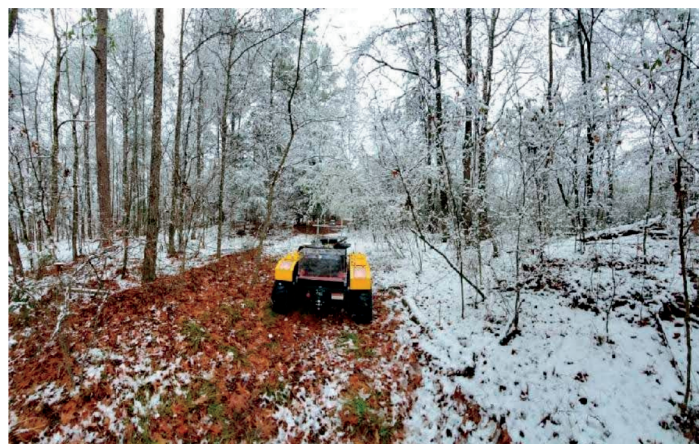# NATURE

Navigating All Terrains Using Robotic Exploration

What is NATURE?

The NATURE (Navigating All Terrains Using Robotic Exploration) stack is a free and open-source autonomy stack for off-road navigation by wheeled vehicles. The NATURE stack features modules for path planning, vehicle control, and perception. Written in ROS, it can be used on real vehicles or coupled to a simulator like the Mississippi State University Autonomous Vehicle Simulator (MAVS). NATURE is publicly available on Github and has online wiki documentation.

Why NATURE?

Autonomous navigation in off-road environments breaks many of the assumptions built into other autonomy algorithms. Without road networks, engineered slopes, and vegetation-free paths, the problem of off-road navigation is more complex than on-road autonomy.
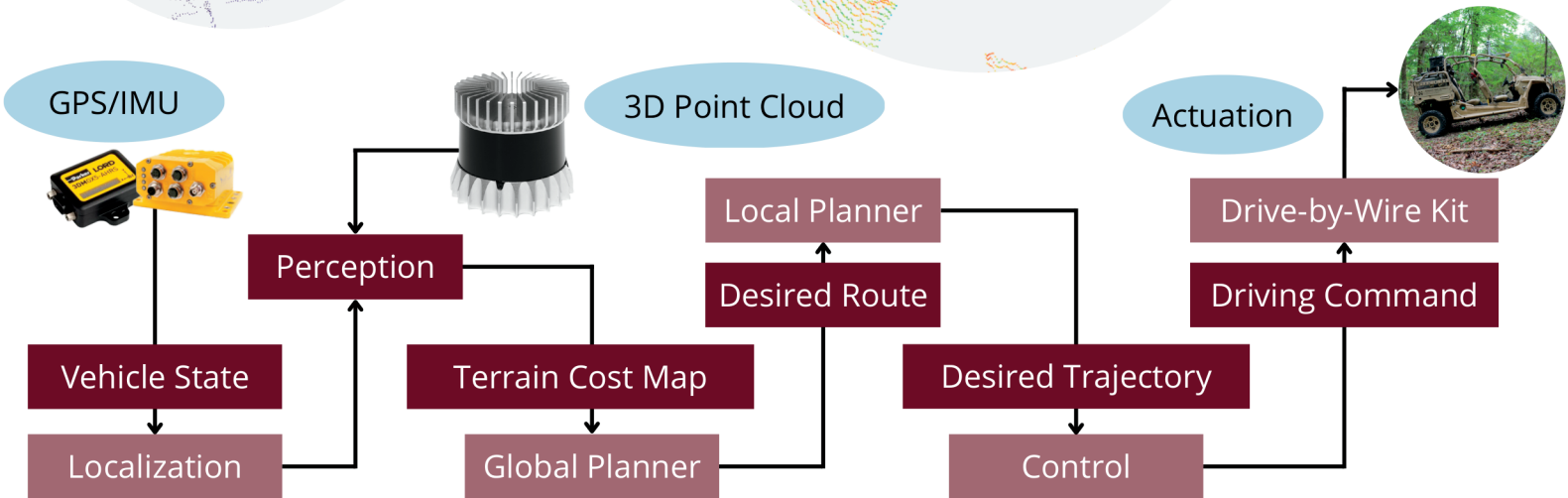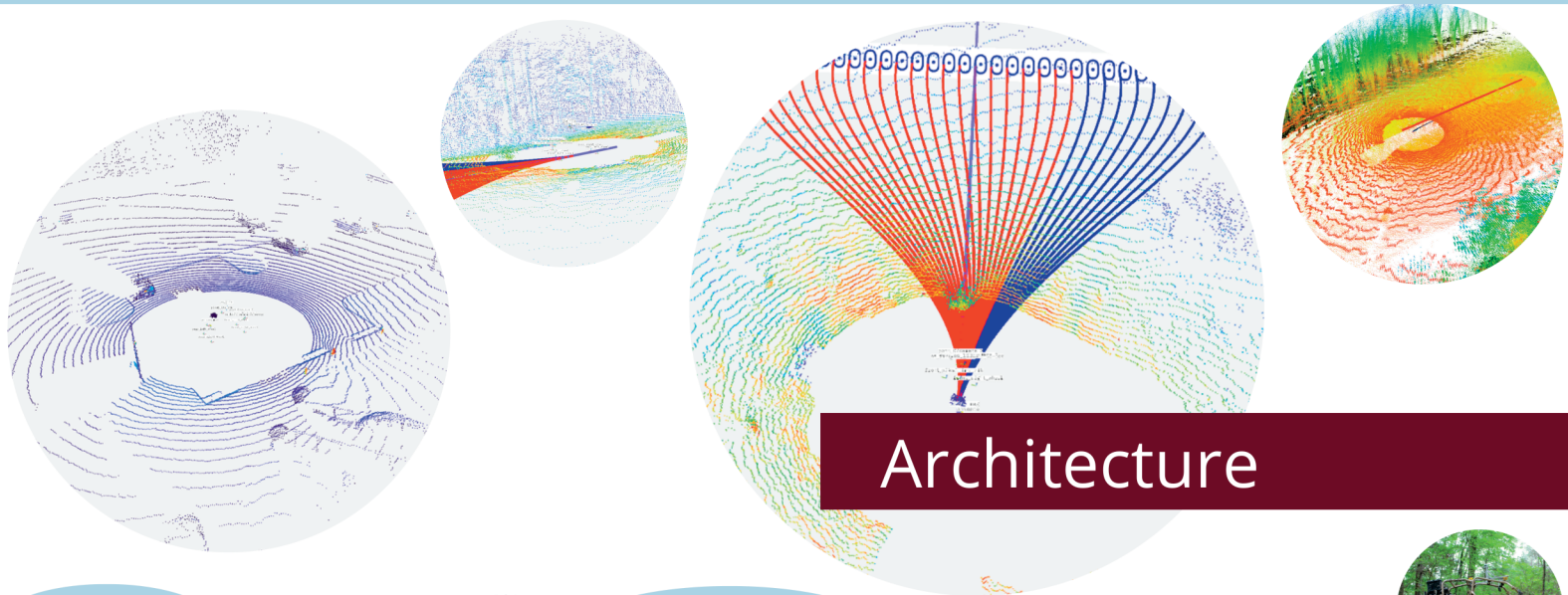
The NATURE stack provides a starting point for researchers interested in studying off-road autonomy by making available a full suite of algorithms (perception, global and local planning, and vehicle control) designed for off-road navigation.
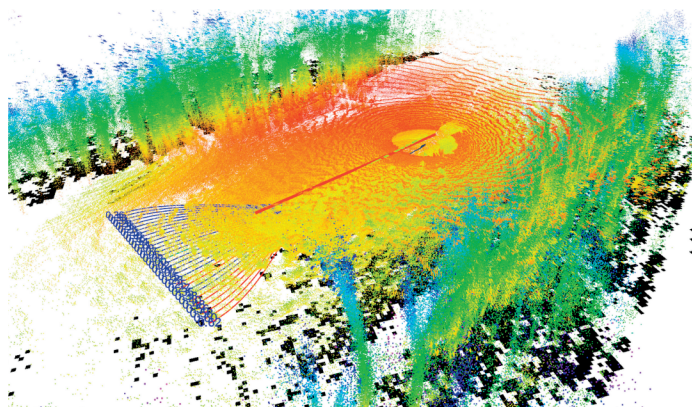
MISSISSIPPI STATE UNIVERSITY™
CENTER FOR ADVANCED VEHICULAR SYSTEMS

Features

- Compatible with ROS 1 and ROS 2
- LIDAR based perception
- Occupancy grid
- A* global path planner
- Multiple local path planner options
  - Spline-based local planner
  - Potential field local planner
- Pure pursuit controller
- Controls for skid-steer and Ackermann steer vehicles
- Field-tested on multiple ground vehicles
- Hooks for Mississippi State University Autonomous Vehicle Simulator (MAVS)
- Customizable for different vehicle and LIDAR configurations

Architecture

GPS/IMU

3D Point Cloud

Actuation

Perception

Local Planner

Drive-by-Wire Kit

Desired Route

Driving Command

Vehicle State

Terrain Cost Map

Desired Trajectory

Localization

Global Planner

Control

NATURE is being used by researchers at the US Army Engineer Research and Development Center to support the development of advanced simulation tools, and provided the foundation for the stack used by the NATO AVT-341 working group on "Mobility Assessment Methods and Tools for Autonomous Military Ground Systems". The NATURE stack supports a variety of ongoing research into off-road autonomy at MSU-CAVS.

MISSISSIPPI STATE UNIVERSITY™
CENTER FOR ADVANCED VEHICULAR SYSTEMS

For more information:
Dr. Daniel Carruth
dwc2@cavs.msstate.edu