

ARMY DEEP GREEN 2022 – AUTONOMOUS ALL-TERRAIN MODEL CHALLENGE

Computer Vision (CV) Competition

Statement of Problem and Challenge Objectives

11 February 2022

Problem Statement.

Future Army Robotic and Autonomous Systems (RAS) will need to operate in a wide variety of environments, from paved streets to rocky deserts; yet ground autonomy research has largely neglected the off-road environments that Army RAS will inevitably encounter. A major barrier preventing RAS from operating in these environments is the challenge of correctly perceiving the environment, often by fusing complementary data modalities from multiple sensors such as visual camera images or 3D Light Detection and Ranging (Lidar) point clouds. To achieve robust perception in a variety of operational domains, datasets from an array of diverse environments should be collected and used to train future perception algorithms. To that end, we present a challenge that focuses on the goal of robust perception in diverse environments. The Army Research Laboratory (ARL) Artificial Intelligence for Maneuver and Mobility (AIMM) Essential Research Program (ERP) will collect and annotate data from several different environments, and the participant challenge will be to use computer vision techniques to train perception models to identify real-world semantic concepts (e.g., objects or terrain). The challenge will task these models to perform on test data taken from new, undisclosed environments. The model test and evaluation (T&E) data and outdoor environments will not be known to participants at any point in the challenge; rather, participants will need to train and validate their algorithms using only the model training data provided by the Army Deep Green Data Science (DS) & Artificial Intelligence (AI) Challenge Sponsors, the ARL AIMM ERP, and Army Office of Business Transformation (OBT) Enterprise Data Analytics (EDA) Office. The Army Artificial Intelligence Innovation Institute (A2I2) will host the data and computing environment for the challenge.

Desired Deliverable.

The goal of the 2022 Army Deep Green DS & AI Autonomous All-Terrain Model Challenge CV Competition is for participants to produce perception algorithms that operate on camera image input.

The algorithms will be tasked with assigning dense semantic labels and corresponding label uncertainties to the input, according to a fixed class ontology that will be provided by ARL AIMM ERP to all participants.

The model training and T&E data, curated and provided by ARL AIMM ERP to all participants, will focus on outdoor environments, but the data used for training will come from different related environments than the data used for testing.

The final deliverable for the competition, submitted by each team to ARL AIMM ERP for evaluation, will consist of self-contained executables that must adhere to specific naming and file location conventions that will be provided as the competitions begin. All algorithms submitted for evaluation must be created by Government personnel and/or consist of open source components which the Government can freely access. Each team is responsible for compliance with any license and/or other restrictions of use for any components which the Government does not own or have adequate rights to use. To those ends, each team shall consult with its home organization's legal office before proceeding with using and/or

incorporating any open source components for this endeavor. All parties hereby agree and acknowledge that any intellectual property (IP), including but not limited to, software, data, algorithms, systems, processes and methods, created through this endeavor shall be deemed property of the U.S. Government. Each team shall be responsible for timely reporting any and all intellectual property (IP) it creates through this endeavor to its home organization. The home organizations, in turn, shall be responsible for review, management and/or protection of IP reported to them by their respective teams on behalf of the U.S. Government.

Each team shall be responsible for ensuring proper review, classification and marking of its deliverables by competent authority of its home organization.

Evaluation/Winner Selection.

The submissions will be evaluated by perception algorithm performance against a common classification accuracy metric, details of which will be provided shortly after the competition start. Submissions will be evaluated according to well-known quantitative performance metrics which will be provided as the competition begins. Winning algorithms will be integrated into ARL AIMM ERP's autonomous software framework, the ARL Autonomy Stack, and will be further tested on live Army autonomous ground vehicles.