

**Artificial intelligence and machine learning in autonomous off-road vehicle mobility****Sergey Vecherin, Aaron Meyer, Jacob Desmond, Orian Welling, Michael Parker***Engineer Research and Development Center Cold Regions Research and Engineering Laboratory, USA***Abstract**

Developing autonomous systems for off-road vehicle mobility is a challenging task, which is in the focus of many researchers. In comparison with the on-road autonomy, the off-road autonomy has unique challenges, such as classification of the terrain, vehicle routing off a known road grid, and determining areas where a vehicle can and cannot go. Moreover, there are no guiding road markings, traffic lights, and signs that would help vehicle navigation. In this paper, we present a concept of merging artificial intelligence and machine learning with vehicles autonomous systems aiming at addressing this task. This forms a terrain-informed intelligent off-road vehicle autonomy system. First, terrain in front of a vehicle is classified using look-ahead sensor systems to determine what kind of surface the vehicle will be driving on. Two approaches are presented and compared for automatic terrain classification, with the emphasis on the snow terrain, which is notoriously difficult for vehicle navigation. The sensors can vary from optical to hyperspectral cameras and lidar systems installed on either the vehicle or an accompanying drone. The terrain classification is implemented by neural networks and by an original machine learning algorithm. Then, the terrain information is transferred to another artificial intelligence system that predicts critical values for vehicle speed, acceleration/deceleration, and steering. These critical values are supplied to the vehicle robotic operation system (RoS) to control vehicle throttle, speed, and steering. The paper presents results and conclusions to date in this on-going research.

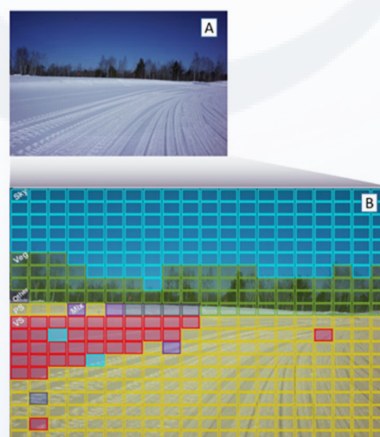


Figure 1. Automatic terrain classification. A: Snow scene as captured by a conventional camera. B: Classification of different features in photo A.

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Biography

Dr. Sergey Vecherin has graduated with Honor from the Moscow State University (Russia) in 1998 with the MS degree in Physics. In 2007, he received a PhD in Physics from the New Mexico State University (USA), which he graduated from with Summa Cum Laude. Since 2008 he is working as a Research Physicist at the Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory (USA). His scientific interests include acoustic and seismic signals propagation, signal analysis, artificial intelligence and machine learning.

