

AI Models and Methods in Safety-Critical Robotic Applications

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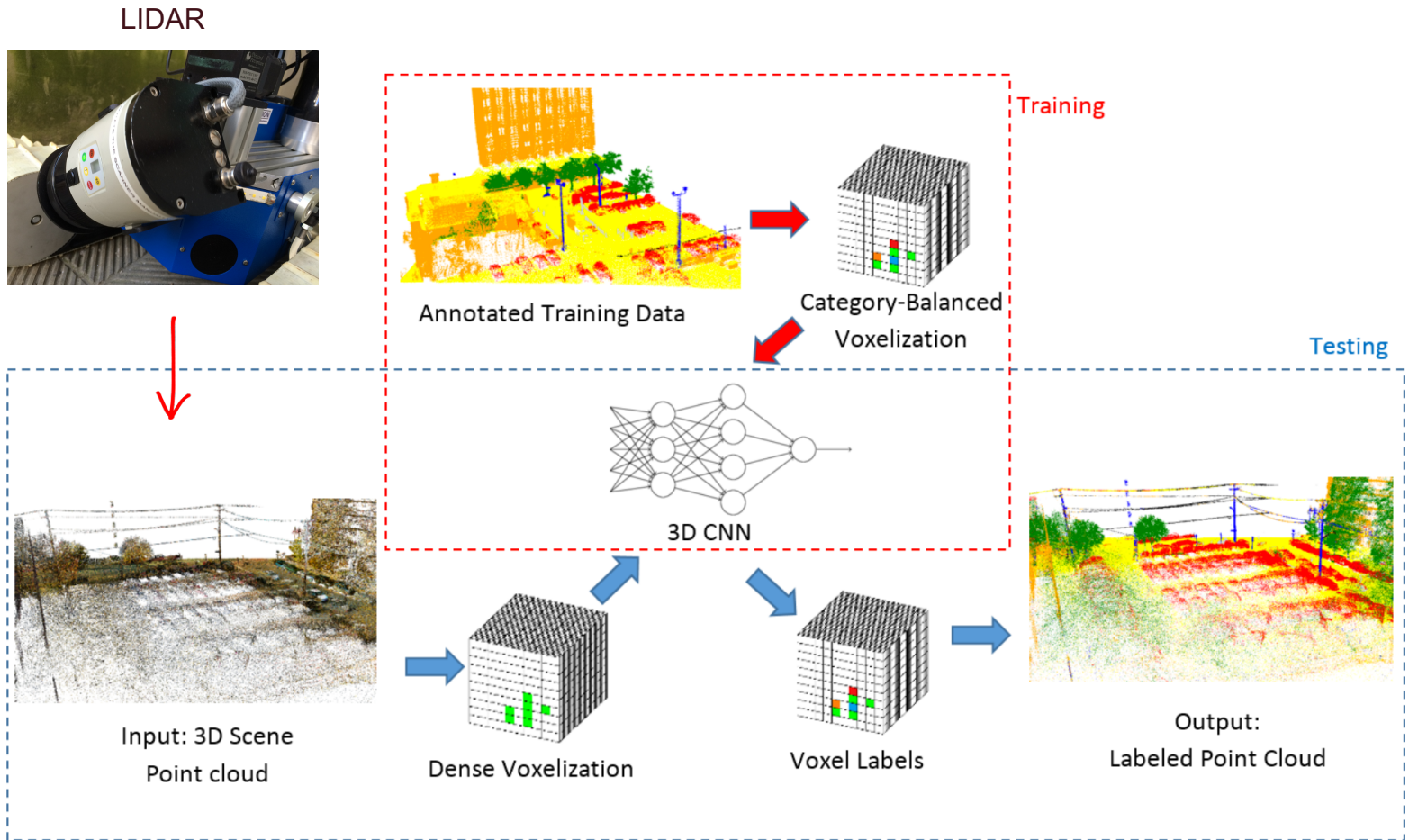


SAPIENZA
UNIVERSITÀ DI ROMA

**Terrain Traversability Assessment in
Perception and Robot Control**

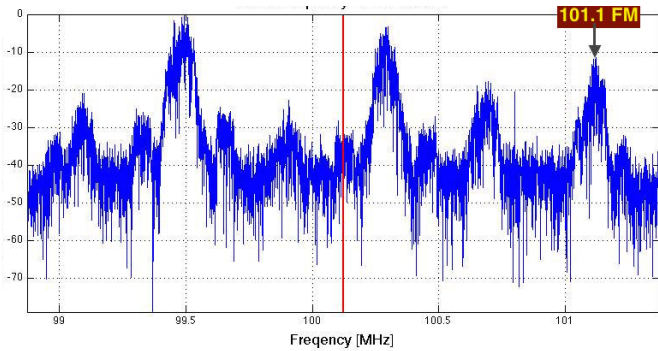
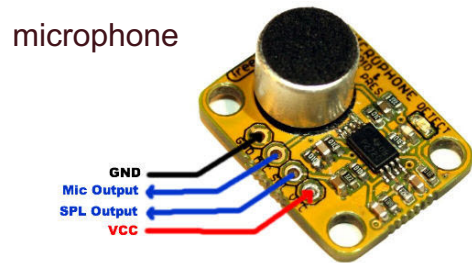
Definition

- Based on the approach



Definition

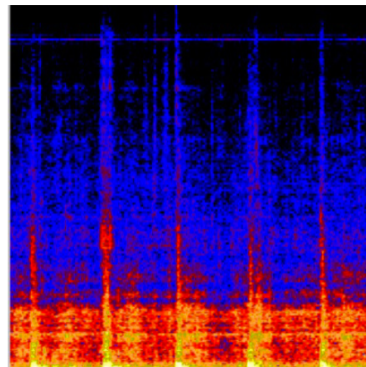
- Based on the approach



raw audio signal



spectrogram

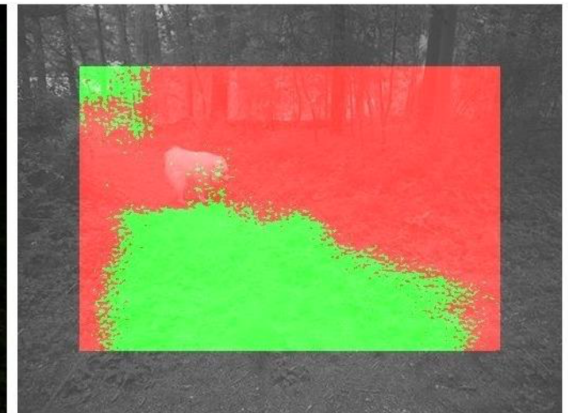
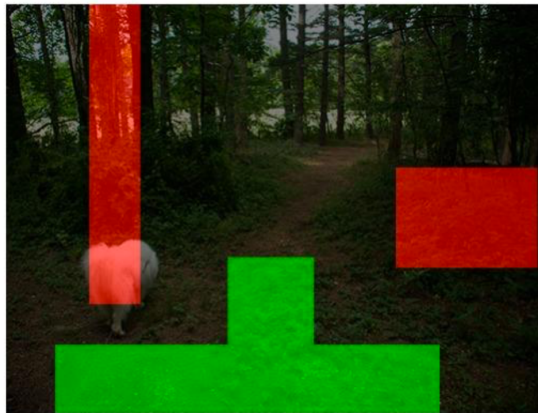
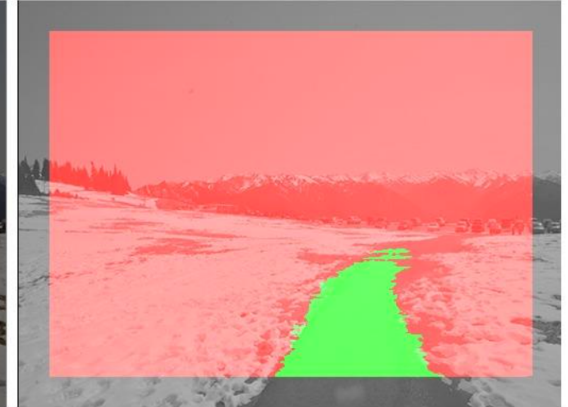
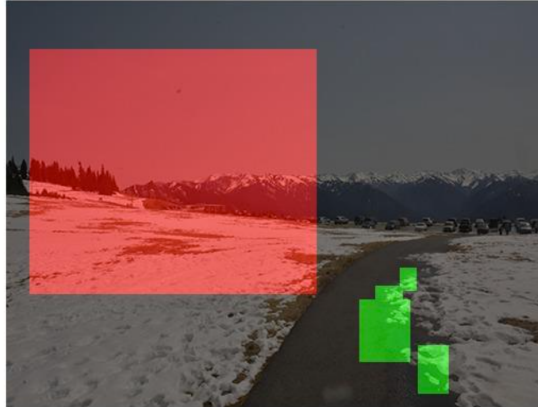


asphalt



Definition

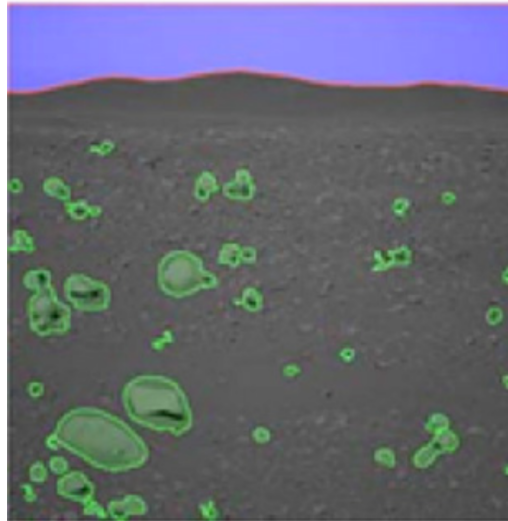
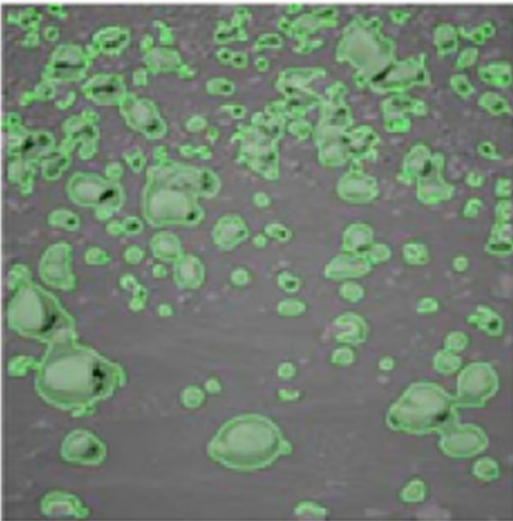
- Based on the domain application
 - off-road navigation



Definition

- Based on the domain application
 - Planetary rovers

rock detection



Martian terrain

State of the art

- **Vision-based**

- suffer from rapid appearance changes due to various factors including
 - illumination variations
 - changes in weather
 - damping



- **LIDAR-based**

- are well-suited
 - under good illumination conditions
 - when visual features span over non overlapping manifolds



- **Vibration-based**

- not affected by the source of disturbances affecting both cameras and LIDARs
- are used as a complementary modality to increase robustness

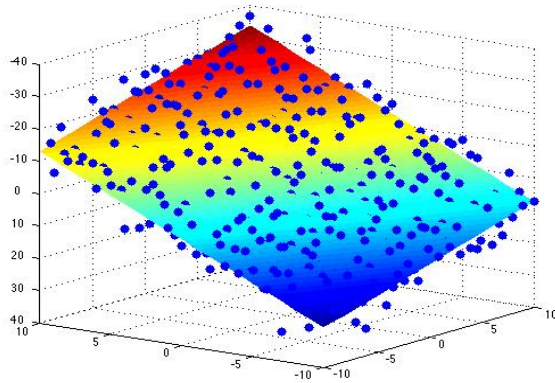
- **Acoustic-based**

- Fine-grained classification.

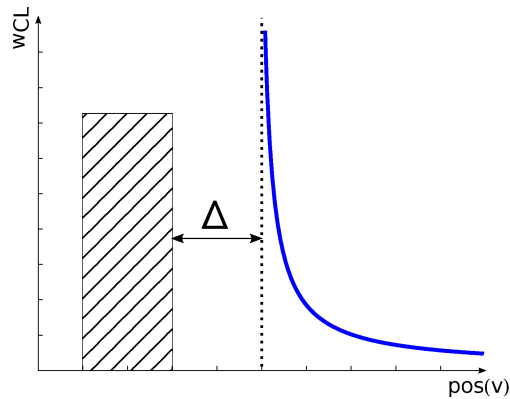


State of the art

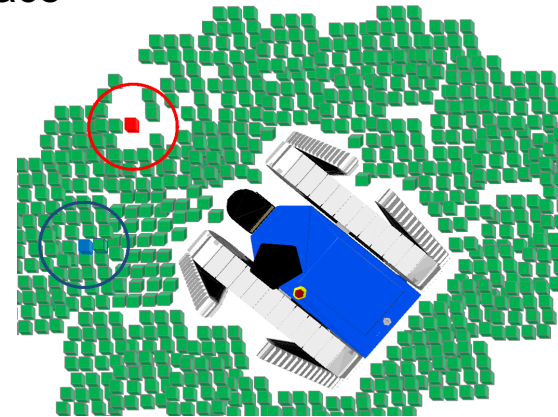
- **Characterization-based**
 - aim at estimating features of the terrain surface



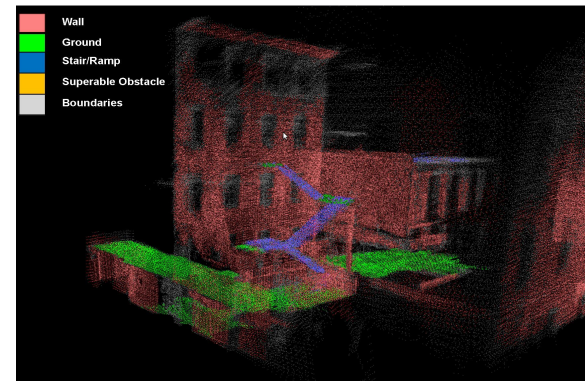
roughness



obstacle clearance



density

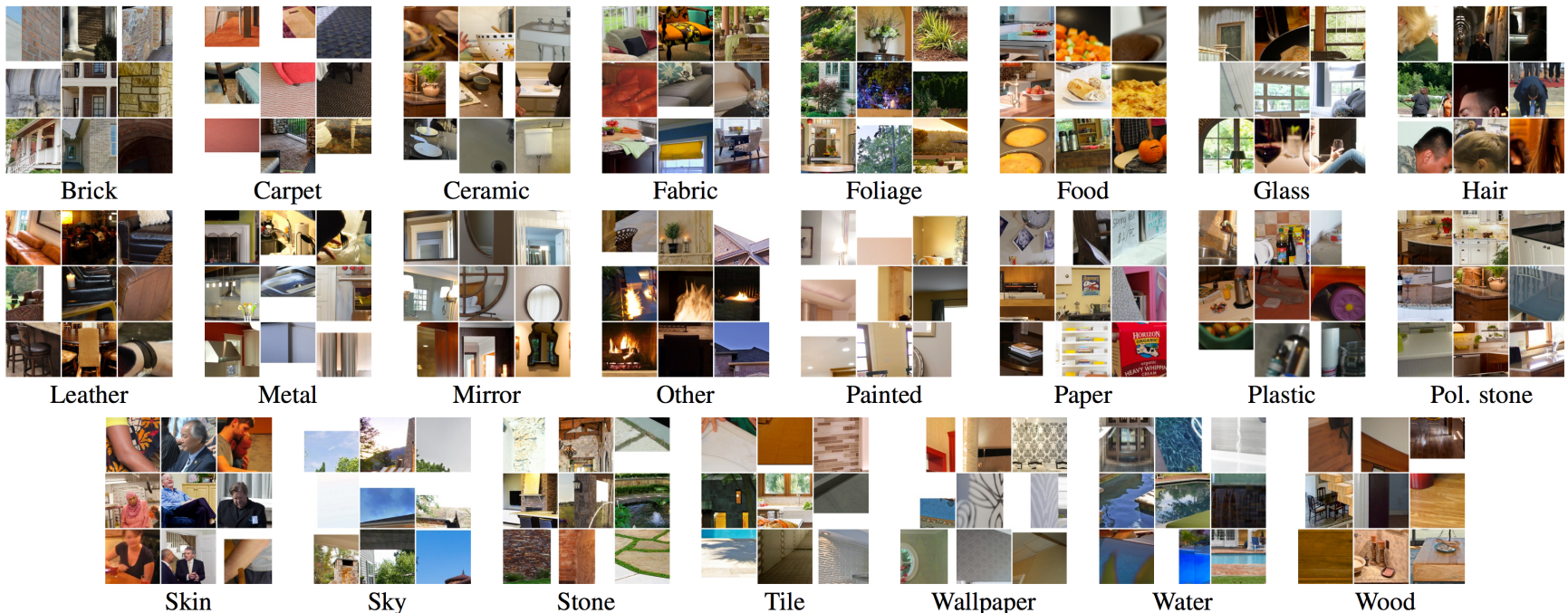


classification

State of the art

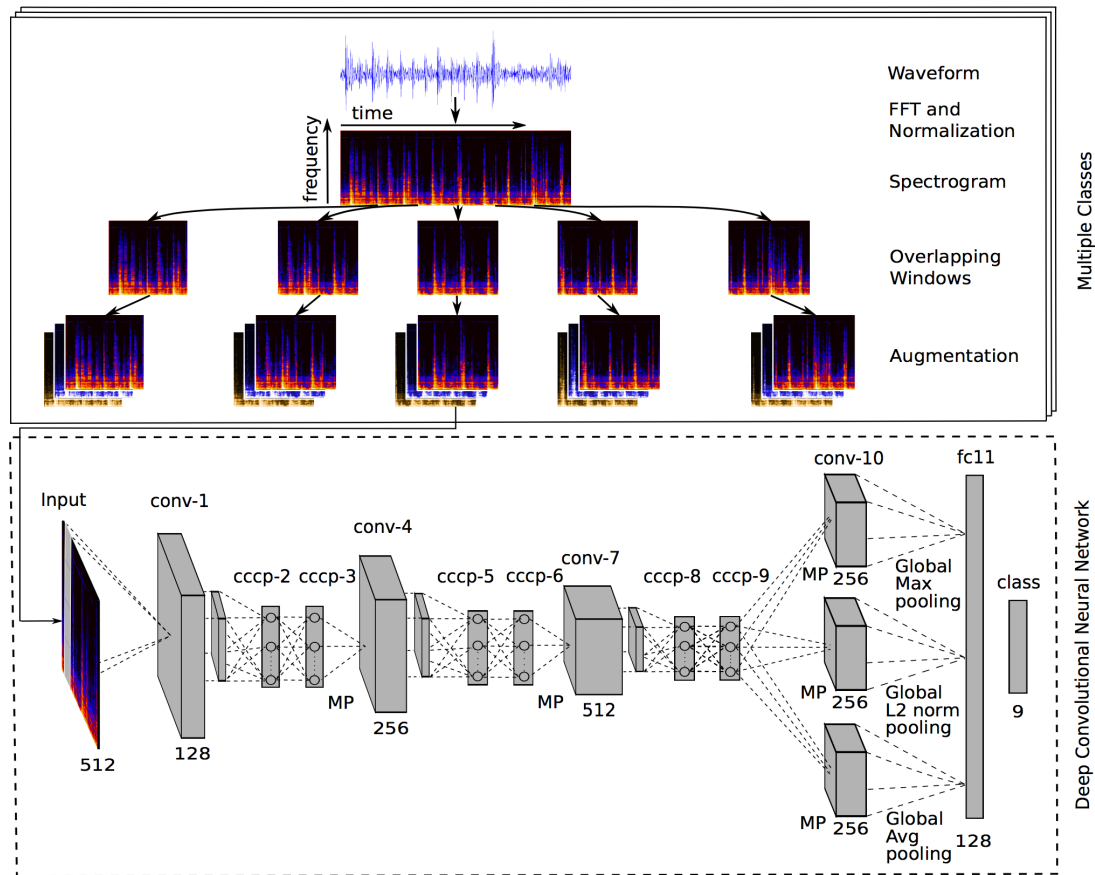
- **Classification-based**

- aim at detecting and recognizing environmental structures (e.g., ground, wall) rather than the type of the material composing the soil (e.g., concrete, stone, mud, wood, metal).



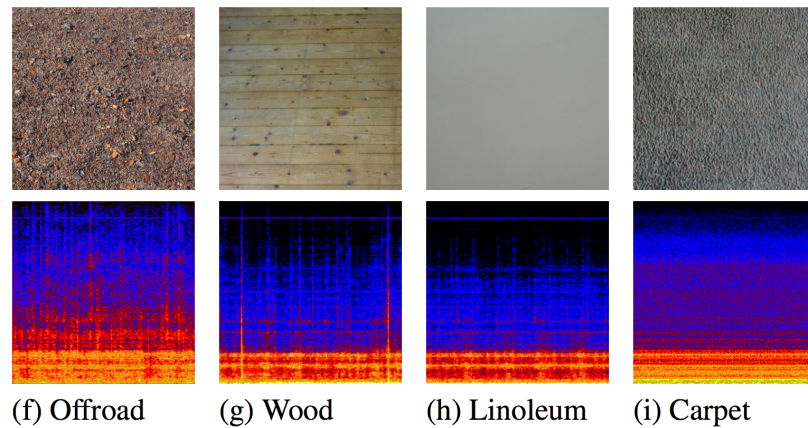
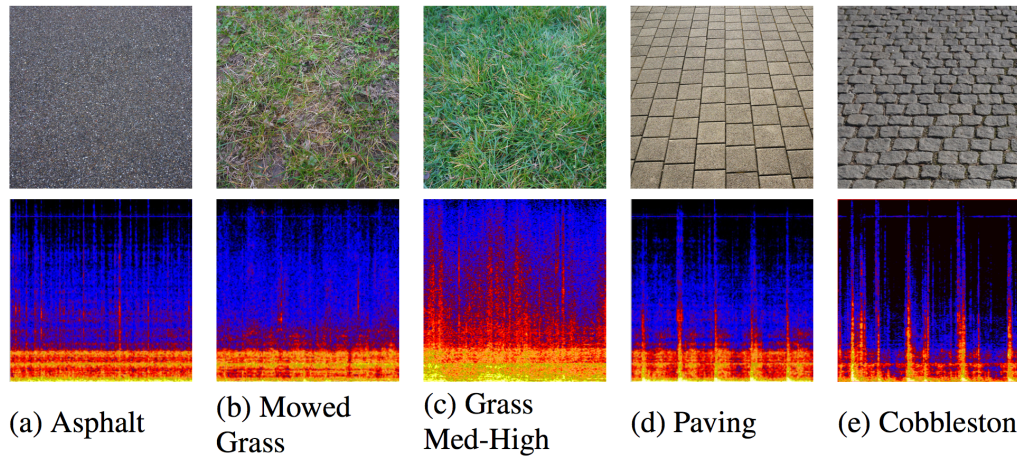
Deep Feature Learning for Acoustics-based Terrain Classification

Authors: Abhinav Valada, Luciano Spinello, and Wolfram Burgard



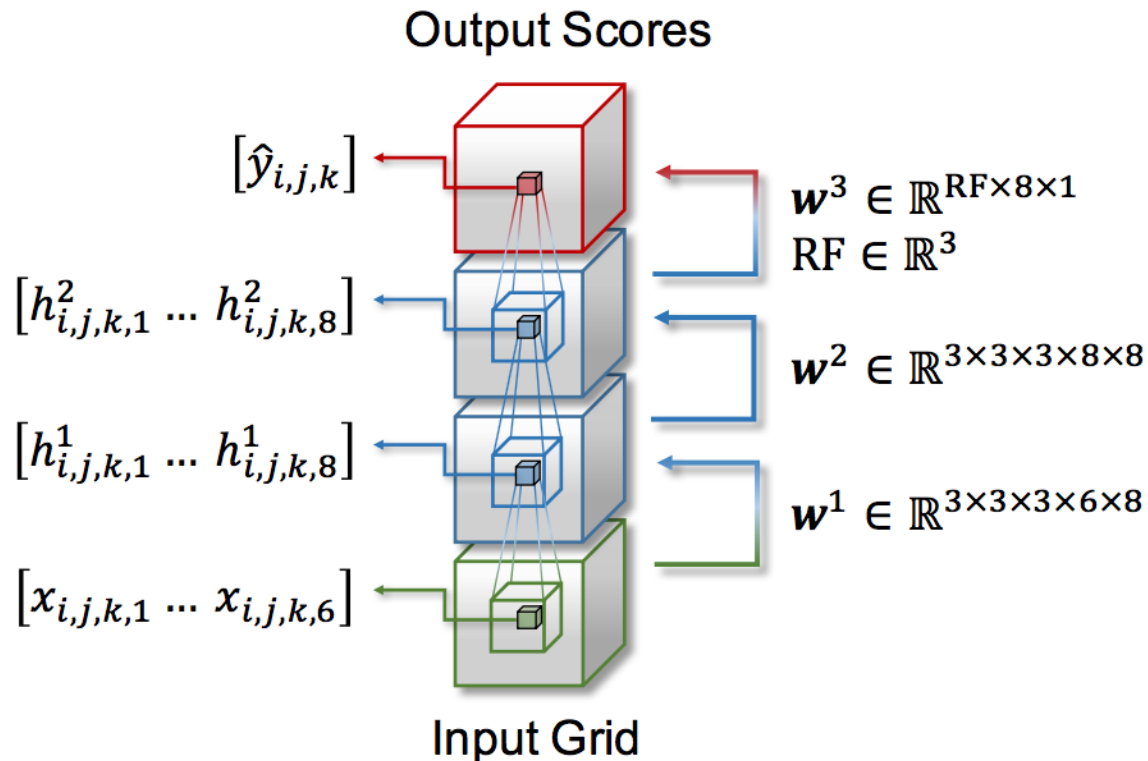
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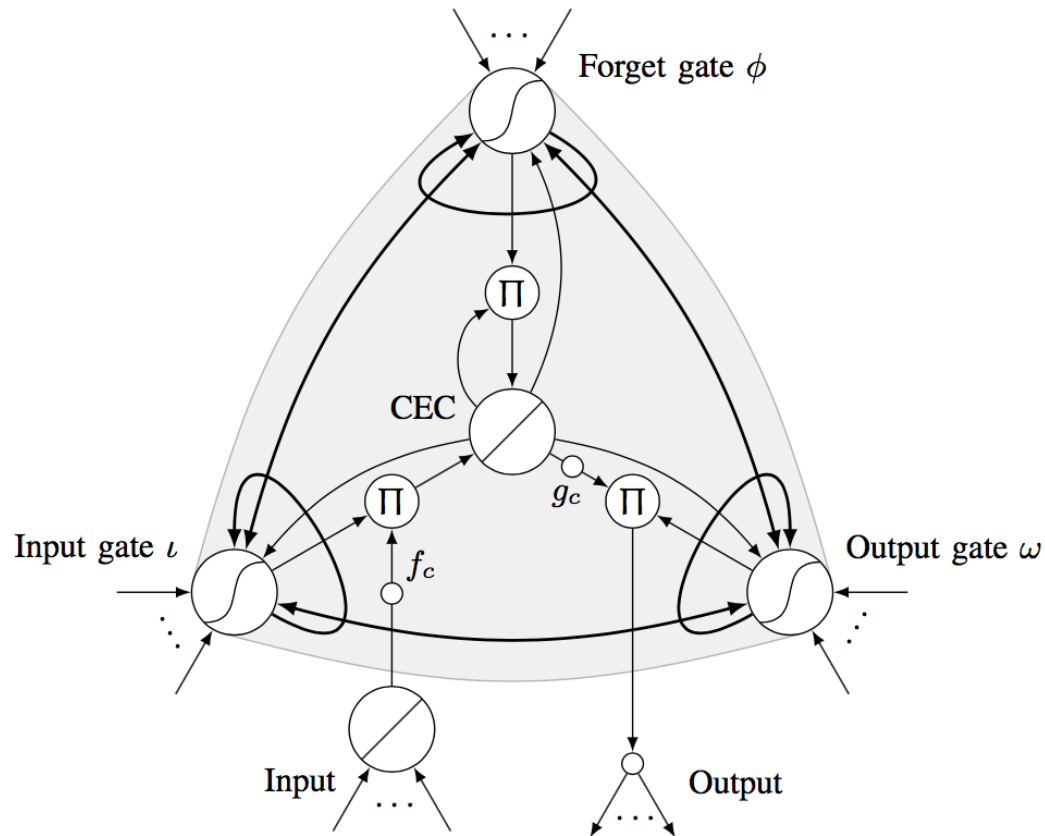
Vote3Deep: Fast Object Detection in 3D Point Clouds Using Efficient Convolutional Neural Networks

Authors: Martin Engelcke, Dushyant Rao, Dominic Zeng Wang, Chi Hay Tong, Ingmar Posner



Recurrent Neural Networks for Fast and Robust Vibration-based Ground Classification on Mobile Robots

Authors: Sebastian Otte, Christian Weiss, Tobias Scherer and Andreas Zell



Recurrent Neural Networks for Fast and Robust Vibration-based Ground Classification on Mobile Robots

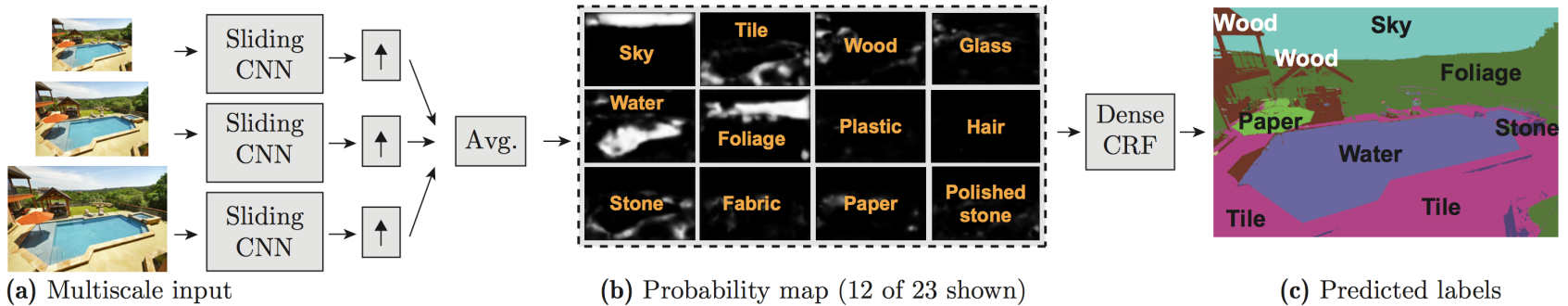
Authors: Sebastian Otte, Christian Weiss, Tobias Scherer and Andreas Zell



Recent advancements

Material Recognition in the Wild

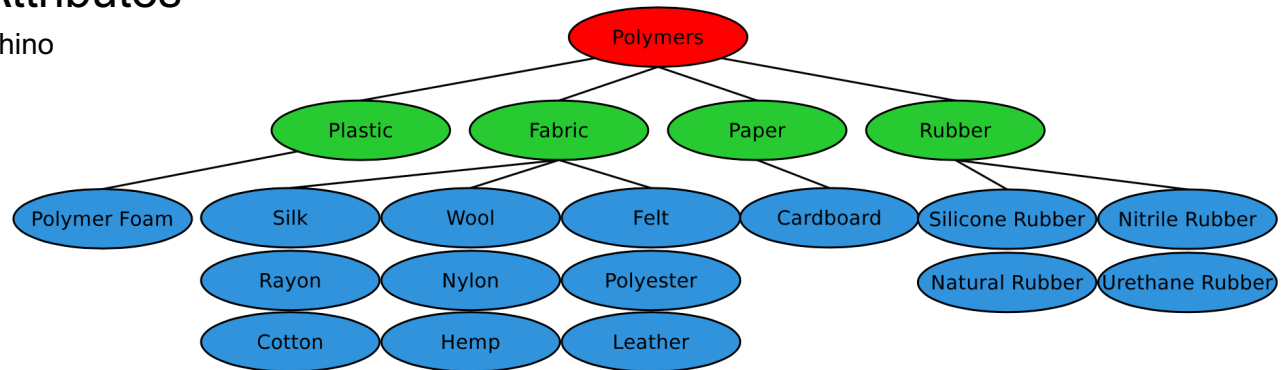
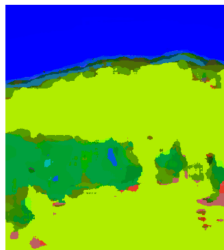
Authors: Sean Bell, Paul Upchurch, Noah Snavely, Kavita Bala



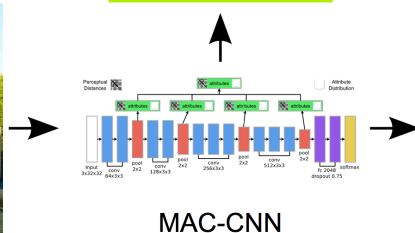
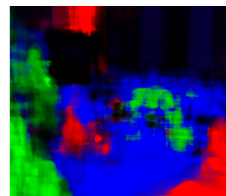
Perceptual Material Attributes

Authors: Gabriel Schwartz, Ko Nishino

Material Attributes



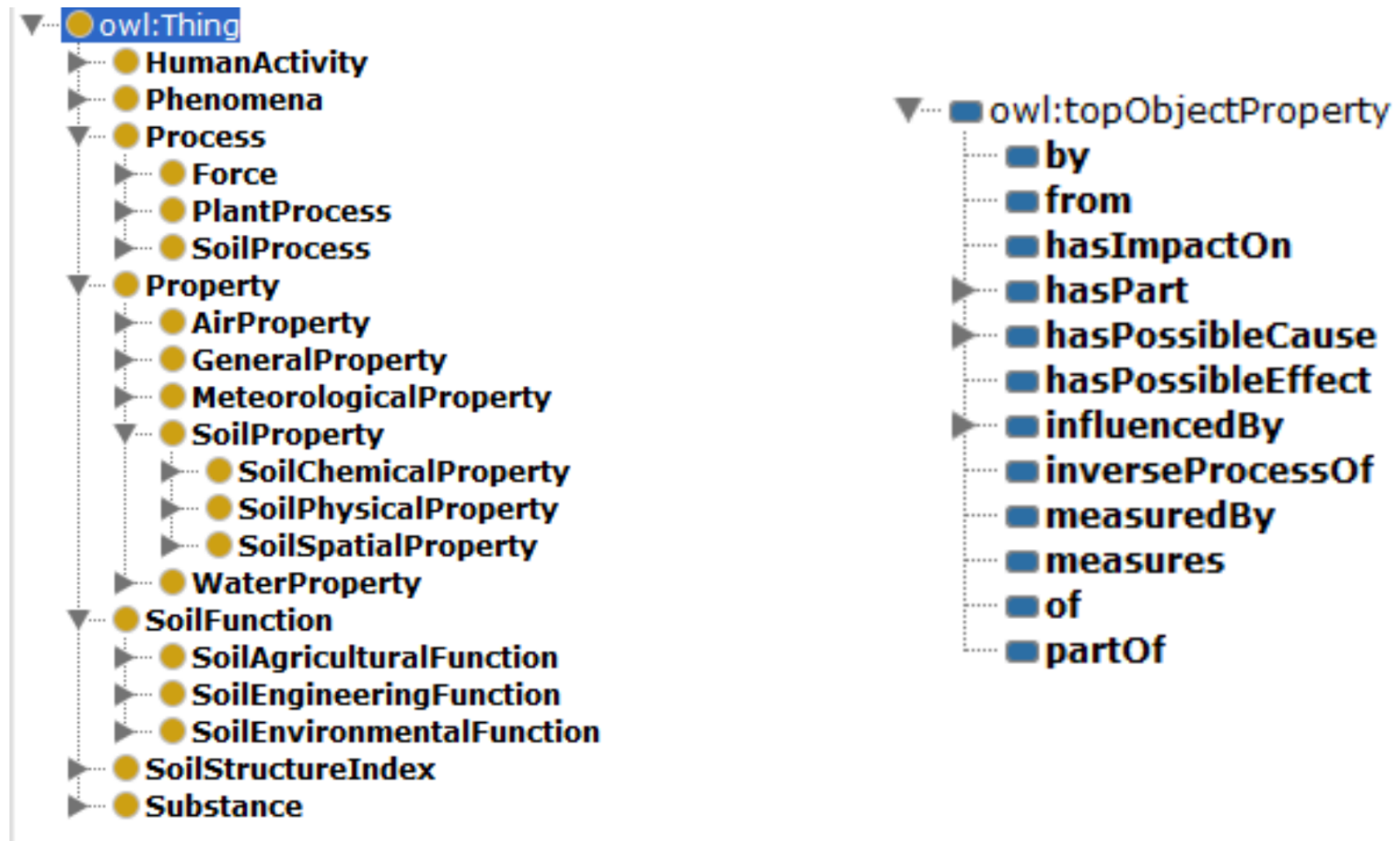
Local Materials



Recent advancements

A Tutorial of Viewing and Querying the Ontology of Soil Properties and Processes

Authors: Heshan Du and Anthony Cohn



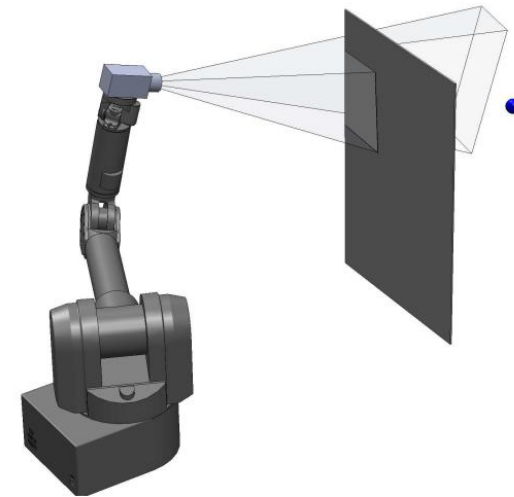
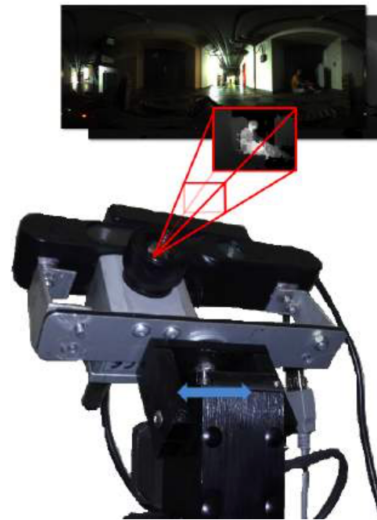
Control policy learning for active vision and beyond

People consistently direct their senses in order to better understand their surroundings.



Can we learn control policies that map raw image observations directly to torques at the robot's motors.

Does training the perception and control systems jointly end-to-end provide better performance than training each component separately?



End-to-End Training of Deep Visuomotor Policies

Authors: Sergey Levine, Chelsea Finn, Trevor Darrell, Pieter Abbeel

