Learning with Limited Supervision

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https://idsia-robotics.github.io/
Dalle Molle Institute for AI (IDSIA)

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A world-class research institute on AI founded in 1988 in Lugano
120+ staff working on:
• Deep learning
• Statistics and data mining
• Visual Computing
• Autonomous robotics
• Natural language processing
• Operations research
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GTC keynote on Tuesday April 5, 2016
Jensen H Huang, CEO of NVIDIA
Robotics lab: People & Robots

People
• 5 Postdoc researchers
• 2 Researchers without PhD
• 3 PhD Students

Robots
• 6 ground (1-10 kg)
• 10+ flying (20-500 g)
• 30+ swarm (50-200 g)

90 sqm robot lab equipped with 18-camera mocap system
Research Themes

Perception for Autonomous Mobile Robots
  • Self-supervised Deep Learning
  • Nano-quadrotors

Human-Robot Interaction

Robot Swarms

Industrial applications
  • Manufacturing / Machining
  • Optical Inspection
  • Space
Visual control of drones in forests


Finalist,
AAAI video awards,
2016, Phoenix, USA
Visual control of nano drones in human proximity

Mategazza et al., ICRA 2019 -- https://github.com/idsia-robotics/proximity-quadrotor-learning
Visual control of nano drones in human proximity

• Full onboard CNN inference and control at **130 frames per second on a 30-gram drone**
• **< 1 mJ per frame** on Parallel Ultra Low Power platform
• **Self-supervised learning** approach improves performance without explicit ground truth

Palossi et al., Internet of Things Journal, 2021 -- https://github.com/idsia-robotics/pulp-frontnet
Optical analysis of circuit boards

Deep Neural Networks **predict multiple component characteristics** (type, number of pins, material, dimensions, ...) for self-programming of Automated Optical Inspection machines.

Deep Neural Networks **trained without ground truth** estimate component precise localization and rotation.

With Delvitech SA
Visual detection of counterfeit brand labels

We have 16 shirts we know are real; 16 we know are fake. Can you train a classifier for this problem?
Training data augmentation to the rescue

Original

Input (file new-authentic/image19.jpg)

6 out of 500 random variations
Training data augmentation
Training data is RARE!

For most real-world ML problems
The ML Pipeline (F. Chollet)

- Define the problem at hand and the data on which you’ll train. Collect this data, or annotate it with labels if need be.
- Choose how you’ll measure success on your problem. Which metrics will you monitor on your validation data?
- Determine your evaluation protocol: hold-out validation? K-fold validation? Which portion of the data should you use for validation?
- Develop a first model that does better than a basic baseline: a model with statistical power.
- Develop a model that overfits.
- Regularize your model and tune its hyperparameters, based on performance on the validation data. A lot of machine-learning research tends to focus only on this step—but keep the big picture in mind.
Plan of the lecture

• Part 1: introduction
• Part 2: warm-up on the CIFAR-10 dataset
• Part 3: what is self-supervised learning?
• Part 4: implement&test a simple self-supervised learning method
• Part 5: some examples of self-supervised learning in robotics
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