Applications of Computer Vision

COMPSCI 527

April 12, 2022

Interpreting the World
Cameras as eyes

- Main goal: semantic understanding

  - What is going on in the world? What is out there? Who does what?

- Interpretation requires reference to past experience

- Deep learning remembers the statistics of a data set ("past experience")

- Works well in predictable scenarios, so that the future resembles the past

- Quantitative predictions, if included, are typically approximate

- Correct *on average* (literally, since training minimizes an average error) and *if* the future resembles the past

Measuring the World
Cameras as measuring devices

- Main goal: inferring geometry

  - What is where, exactly? What are the 3D shapes of objects?

- Accurate measurements are often needed

  - Examples: quality control, architectural surveys, fitting clothes, virtual models of existing objects or places, …

- Geometry supports inferences based on provable relationships

- Works well in controlled scenarios (known cameras, controlled lighting, …)

- Correct *under specific assumptions* on scene, imaging, and lighting

- Requires no training data

One System Can Do Both
The line between interpretation and measurement may be blurry

- The Tesla networks recognize vehicle, people, signs, traffic cones…

- They do stereo vision as well

  - Arguably, correspondence is interpretation (x is the same as y)

  - Stereo triangulation is definitely a measurement

- Tesla believes that deep learning will "eat up" *all* of computer vision

- This may work in a predictable scenario, but likely not when exact measurements are the main goal

- In measurement, we want accuracy, not just plausibility given a data set

- Systems of the two types are likely to continue to coexist

Video Credits
Downloaded from YouTube on 4/20/2021

- *Andrej Karpathy*: AI for Full-Self Driving at Tesla
  https://www.youtube.com/watch?v=hx7BXih7zx8

- *Dronegenuity*: Aerial Photogrammetry Explained
  Create 3D models with Drone Photos
  https://www.youtube.com/watch?v=Blr3suSQt-Q

- *School of Motion*: Getting Started with Photogrammetry
  Using Your Cell Phone
  https://www.youtube.com/watch?v=ZIW4XU6Wm8Q

- *Capturing Reality:* Urban Photogrammetry
  Steps Cottage by 3 Pivot
  https://www.youtube.com/watch?v=E17XQdC3DVU