Prof. Rozenn Dahyot

Associate Professor in Statistics
School of Computer Science & Statistics
Trinity College Dublin
https://www.scss.tcd.ie/Rozenn.Dahyot/

Distributed multi-sensor data fusion for 3D mapping & AI applications

https://www.meetup.com/Machine-Learning-Dublin/events/251878496/

#MLDublin meets Valeo @ DogPatch Labs

2018/06/25

Why do we need a Digital twin of the world?

- City planning (Future cities)
- Virtual visits
- Games, education
- Data visualisation
- Navigation (cars, drones)
- Creating data for training AI !
  - Driverless cars
  - Autonomous drones
- Asset management
- Environment monitoring (e.g. vegetation, pollution, ..)
- Disaster prevention & emergency response (floods, earthquakes,…)

Multiple source of Data
- Drones
- Social media
- Google Street view
- OpenStreetMap
- Satellite imagery
- Lidar
- …

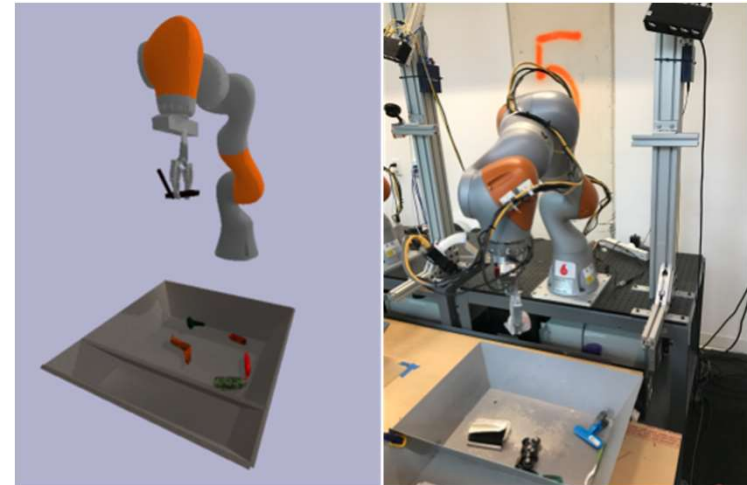# Importance of virtual environments in AI

GitHub, Inc. [US] | https://github.com/Microsoft/AirSim

Drones in AirSim

AirSim Demo

Closing the Simulation-to-Reality Gap for Deep Robotic Learning
https://arxiv.org/abs/1709.07857 (2017, Google Brain)

Cars in AirSim

AirSim Car Demo

C | Secure | https://developer.nvidia.com/isaac-sdk?nvid=nv-int-gg-34917

NVIDIA Isaac SDK

Accelerate Your Creation of Autonomous Machines

Home > Autonomous Machines > NVIDIA Isaac SDK

The NVIDIA Isaac software development kit (SDK) makes it easy for developers to create and deploy AI-powered robotics. The SDK is a collection of libraries, drivers, APIs, and other tools that will save you hundreds of hours by making it easy to add AI into next-generation robots for perception, navigation, and manipulation.
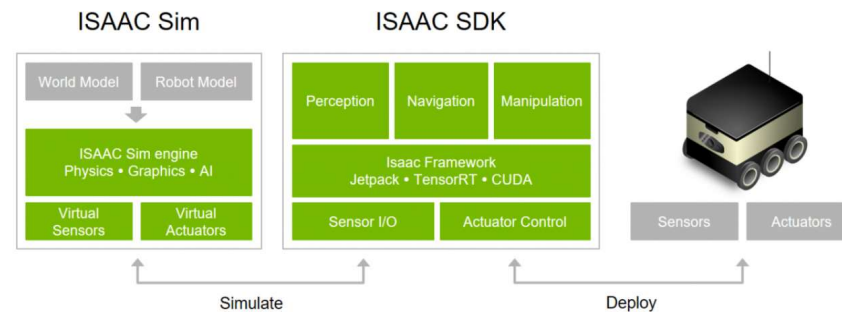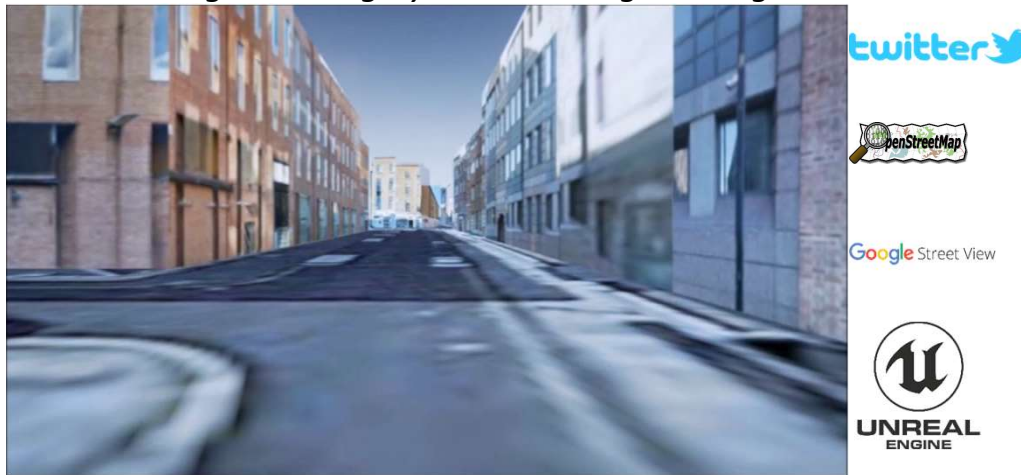
Digital Twin of the world using online data

Google Street View navigation

Popularity Visualization

TCD AI: using GSV imagery and OSM in game engine

twitter

OpenStreetMap

Google Street View

UNREAL ENGINE

6:12

EU FP7 GRAISearch: https://www.youtube.com/channel/UCY_bkYqwO4K_jZzodE-LP5Q

- **Social Media based 3D Visual Popularity**
  A. Bulbul and R. Dahyot, Computer & Graphics (2017) DOI:10.1016/j.cag.2017.01.005
- Populating Virtual Cities using Social Media
  A. Bulbul and R. Dahyot, Computer Animation and Virtual Worlds journal (2016) DOI:10.1002/cav.1742

Trinity College Dublin Drone Survey Dataset
J. Byrne, J. Connelly, J. Su, V. Krylov, M. Bourke, D. Moloney & R. Dahyot, Tech Report and Dataset (2017). http://www.tara.tcd.ie/handle/2262/81836

Applications of the VOLA Format for 3D Data Knowledge Discovery. Byrne, Jonathan & al (2017). International Conference on Natural Computation, Fuzzy Systems and Knowledge Discovery

Interactive Demo Virtual visit at
https://www.scss.tcd.ie/Rozenn.Dahyot/TCDCampusWebGL2/

EU project **VARCITY (Variation & the City)**
(2012-2017, PI: Luc S. J. Van Gool)
https://varcity.ethz.ch/

erc

European Research Council
Established by the European Commission

Target. Automatic discovery and geotagging of recurring stationary objects from **Street Level** imagery:

- Utility companies' assets

- Street signage

- Vegetation

Detection and geotagging: Google Street View
Visualisation: Google Maps

AI *MapIT*

Info @ https://www.adaptcentre.ie/case-studies/aimapit

remote sensing

"*Automatic Discovery and Geotagging of Objects from Street View Imagery*".
V. A. Krylov, E. Kenny, R. Dahyot. *Remote Sensing* (2018). https://doi.org/10.3390/rs10050661

➤ **Vision module:** fully convolutional neural networks (FCNN) for semantic segmentation and monocular depth estimation

Average processing speed of 200km/h on desktop PC
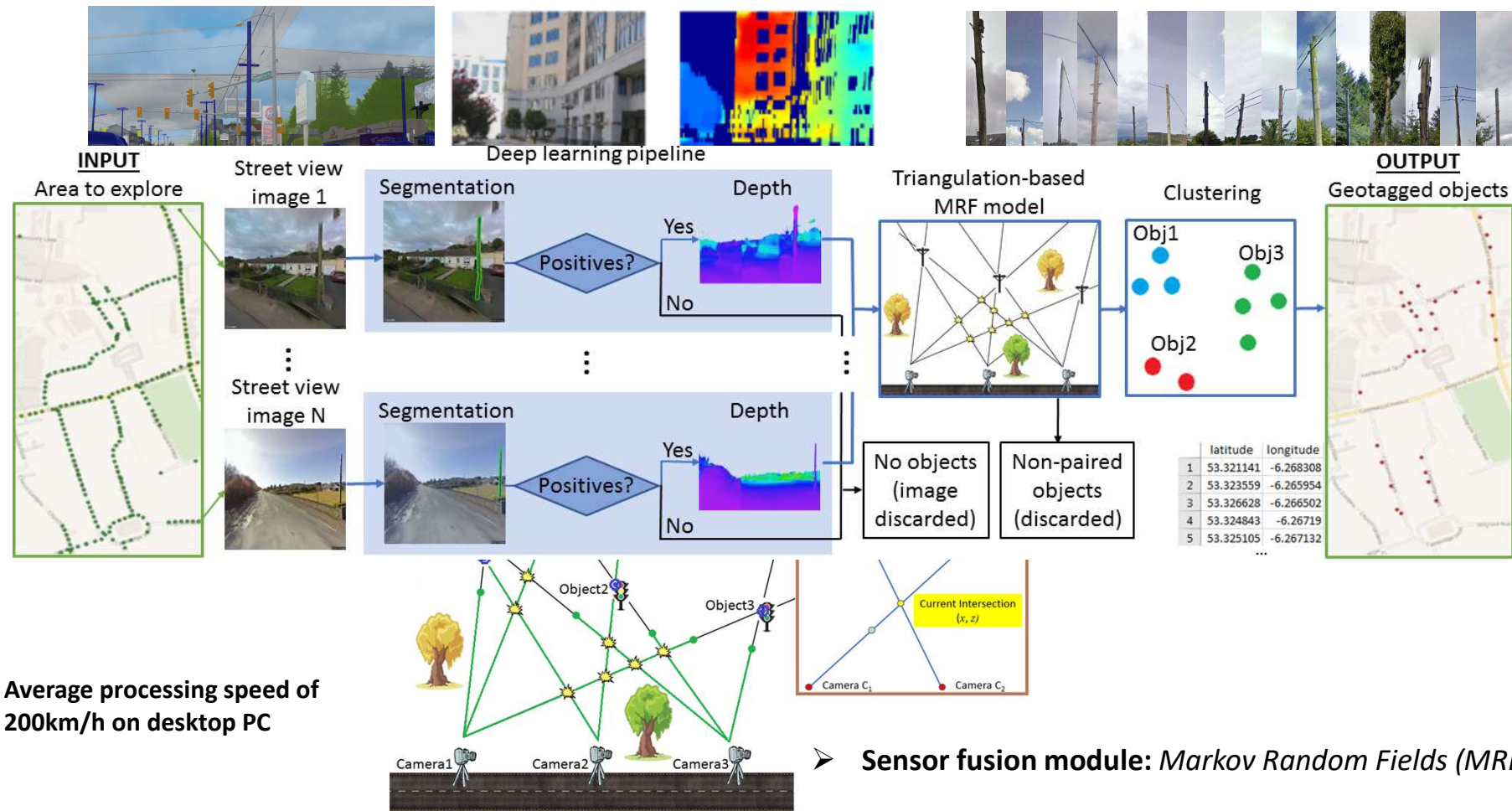
➤ **Sensor fusion module:** *Markov Random Fields (MRF)*

V. A. Krylov, R. Dahyot. "Object Geolocation using MRF-based Multi-sensor Fusion", *IEEE International Conference on Image Processing (ICIP 2018 - to appear)*
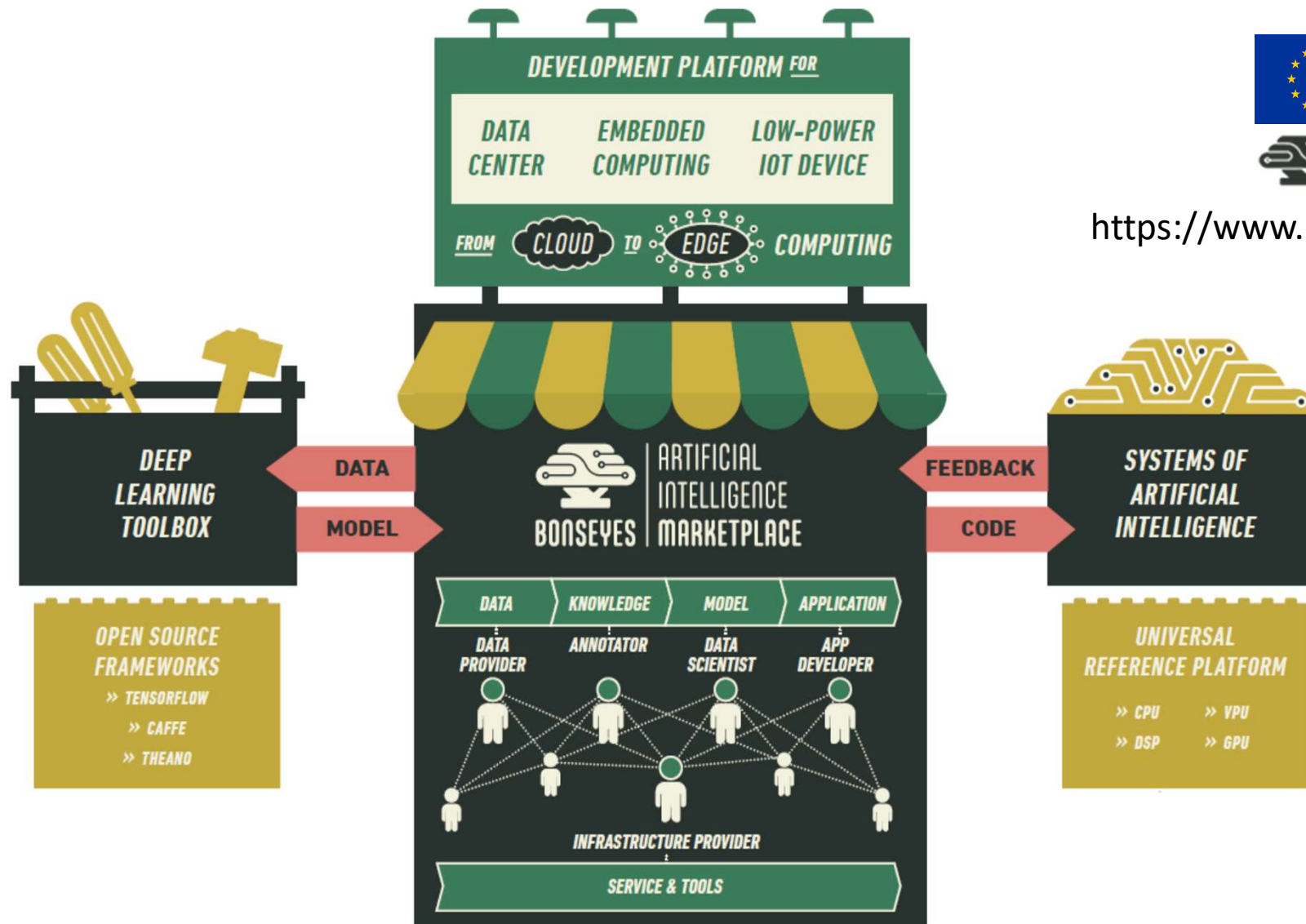
https://www.bonseyes.com/
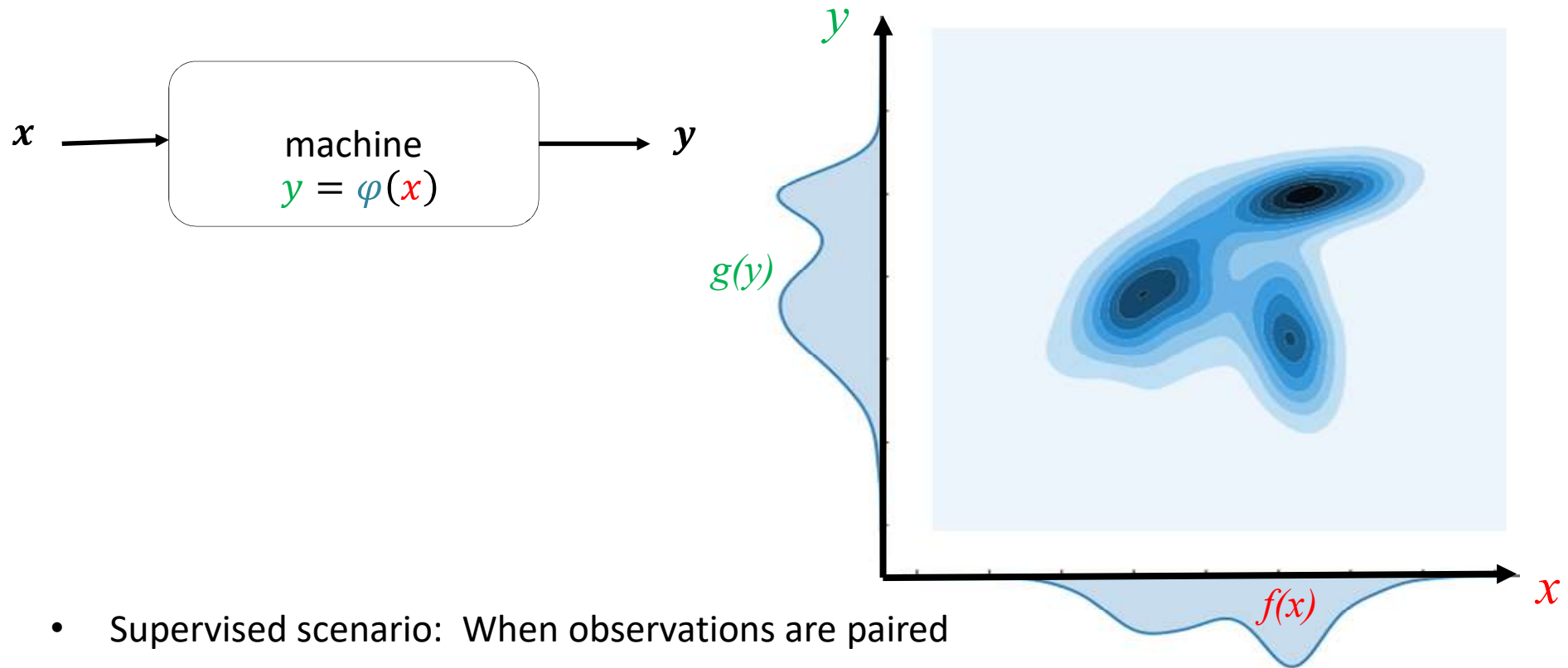
$$x \longrightarrow \boxed{\begin{array}{c} \text{machine} \\ y = \varphi(x) \end{array}} \longrightarrow y$$

y

$g(y)$

$f(x)$

x
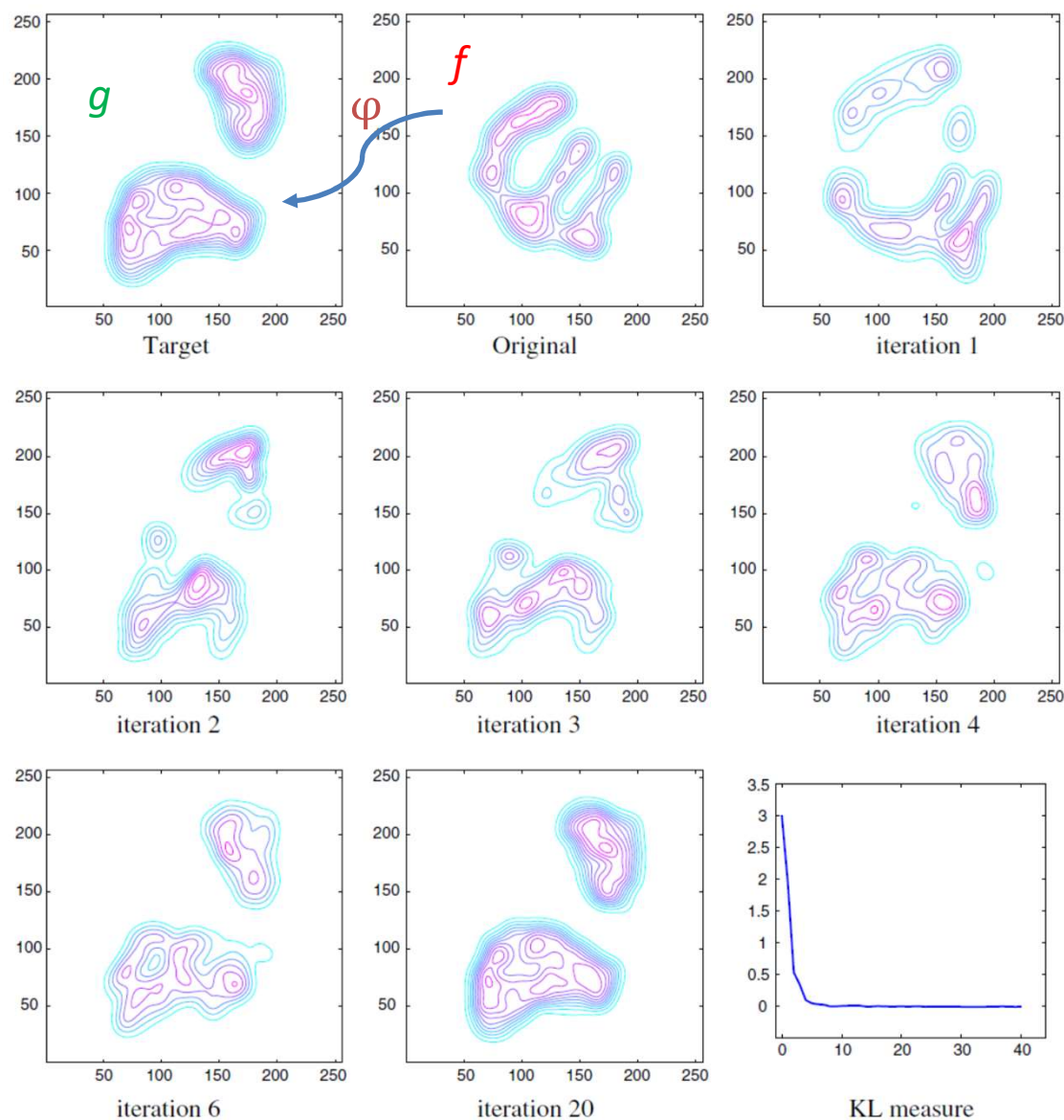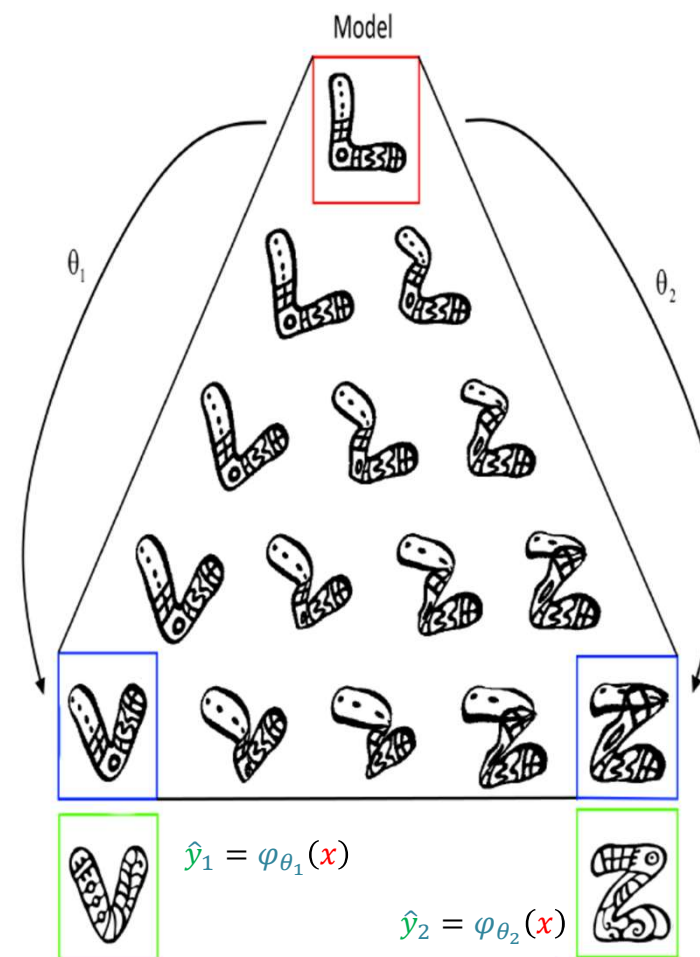
- Supervised scenario: When observations are paired

  - $\{(x^{(i)}, y^{(i)})\}$

- Unsupervised scenario: When observations are not paired

  - $\{(x^{(i)})\}$ $\{(y^{(j)})\}$

Example
$x \in \mathbb{R}^2$ and
$y \in \mathbb{R}^2$

Model

$\hat{y}_1 = \varphi_{\theta_1}(x)$

$\hat{y}_2 = \varphi_{\theta_2}(x)$

Shape Registration with Directional Data
M. Grogan & R. Dahyot, Pattern Recognition (2018) DOI:10.1016/j.patcog.2018.02.021

Video credit @gabrielpeyre

Optimal transport

https://youtu.be/FLhabslT4y4
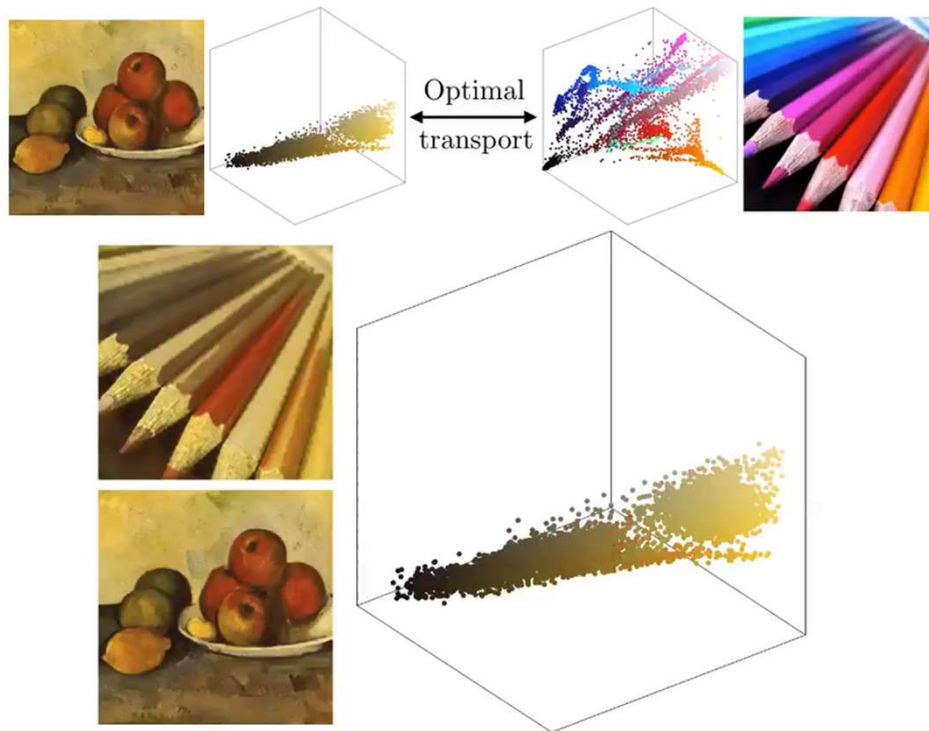
Automated Colour Grading using Colour Distribution Transfer
F. Pitie, A. Kokaram & R. Dahyot,
Computer Vision and Image Understanding (2007) DOI:10.1016/j.cviu.2006.11.011

Robust Registration of Gaussian Mixtures for Colour Transfer
M. Grogan and R. Dahyot
arxiv.org/abs/1705.06091 (2017)
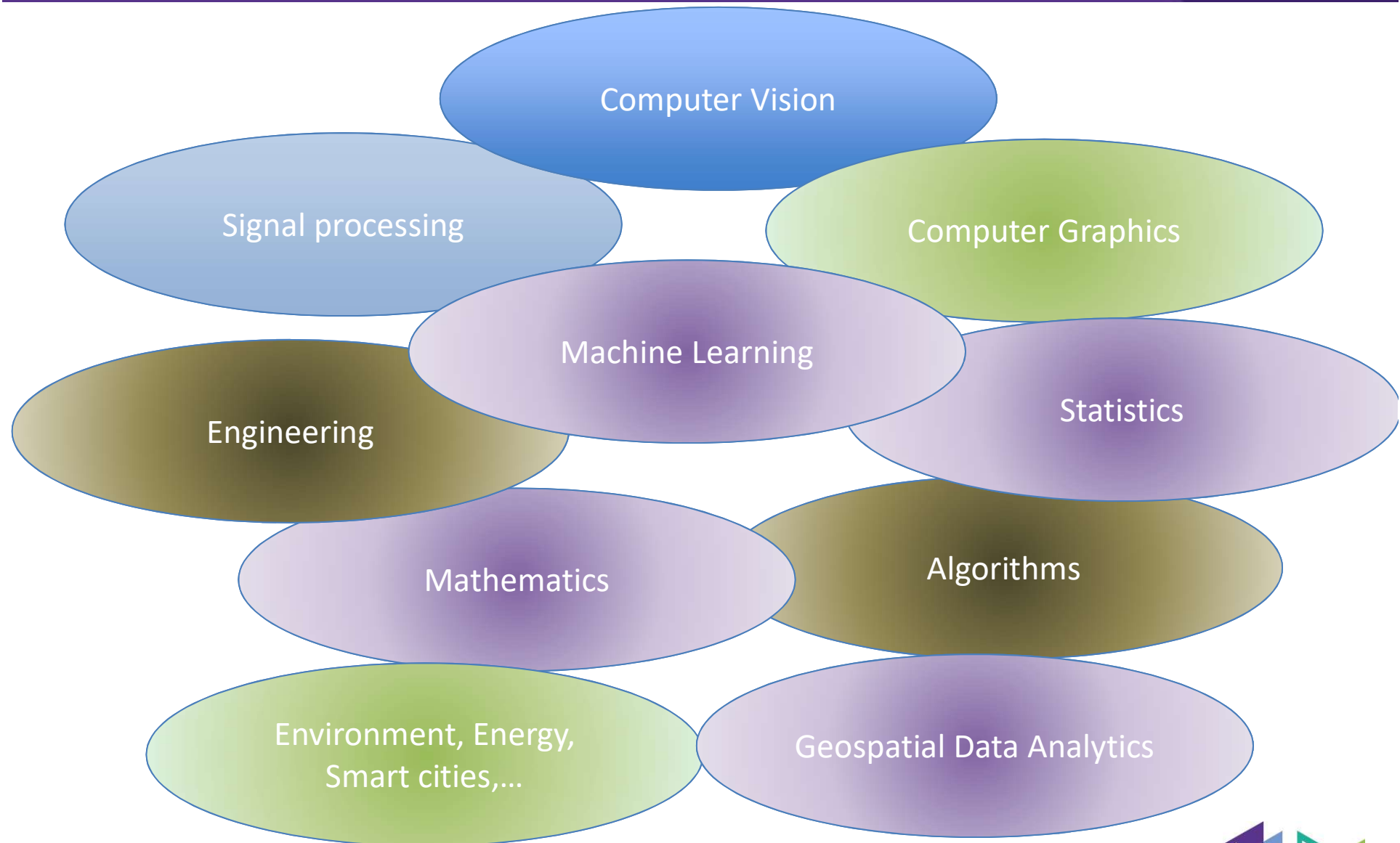
User Interaction for Image Recolouring using L2
M. Grogan, R. Dahyot and A. Smolic, in Conference on Visual Media
Production (CVMP), London, December 2017 DOI:10.1145/3150165.3150171

Computer Vision

Signal processing

Computer Graphics

Machine Learning

Engineering

Statistics

Mathematics

Algorithms

Environment, Energy, Smart cities,…

Geospatial Data Analytics

…

Questions?

Thank you!

Prof. Rozenn Dahyot & Co
https://www.scss.tcd.ie/Rozenn.Dahyot/Research.html#Team