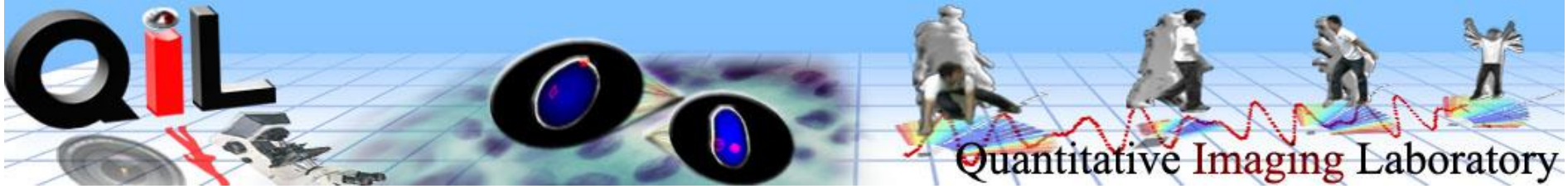

Computer Vision Research

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Computer Vision

- What is Computer Vision?
  - ``to know what is where, by looking.'' (Marr)
  - to understand a single image of a scene, locate and identify objects, their structure, and spatial arrangements, and relationships with other objects
  - Biological vision system as a model
- Images and videos are everywhere – virtual eyes
- Challenge is to distill relevant and intelligent information from the vast amount of spatio-temporal data and enable "interesting" applications
- Fascinating science at the interface of computer science, engineering, mathematics, physics, psychology, physiology, sociology, …

Quantitative Imaging Laboratory

Members

Graduate Students

Qazaleh Mirsharif, Li Wei, Charu Hans, Pranav Mantini, Lijuan Zhao, Can Cao, Arko Barman, Ilyes Sghir, Adrien Sitter, David Chotard

Undergraduate Students

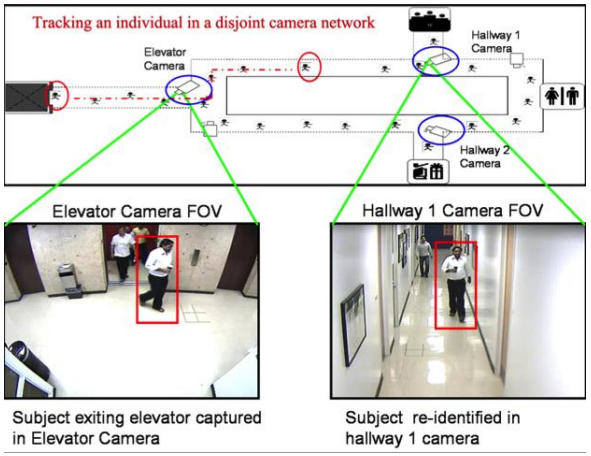
Igor Oliviera, Chirag Ghanshani

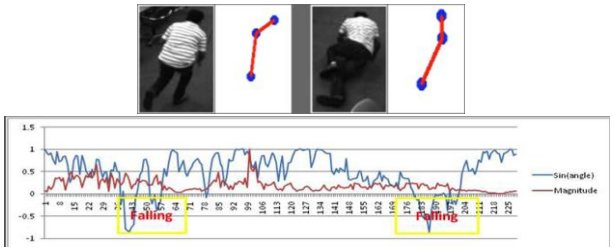
Alumni

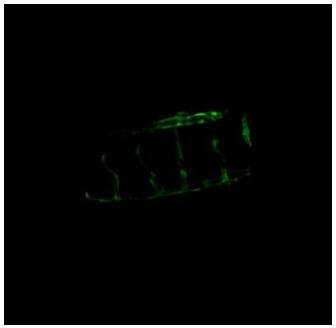
James Thigpen (MS 2008), Vyom Munshi (MS 2010), Prashanth Vishwanath (MS 2010), Ashish Kapadia (MS 2012), Sandeep Belure (MS 2012), Divye Kumar (MS 2012), Xuqing Wu (PhD 2012), Arijit Bose (MS 2012), , Joseph Mathew (MS 2012), Daniel Biediger (MS 2013), Benjamin Soibam (PhD 2013), Khai Tran (PhD 2013), Hakan Haberdar (PhD 2013), Varun Maheshwari (MS 2013), Apurva Gala (PhD 2014), Xu Yan (PhD 2014)

Research Interests

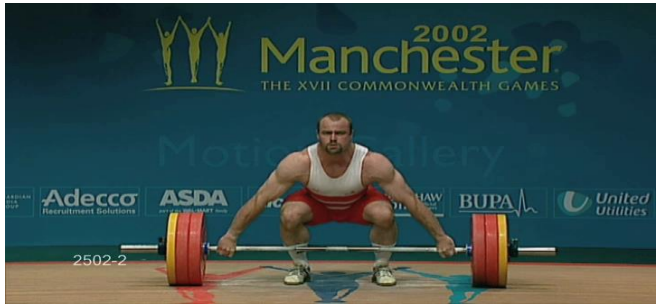
- Object Detection & Tracking
- Human Activity Analysis
- Object Recognition
- 3D from Motion
- Probabilistic Inference
- Inverse Problems

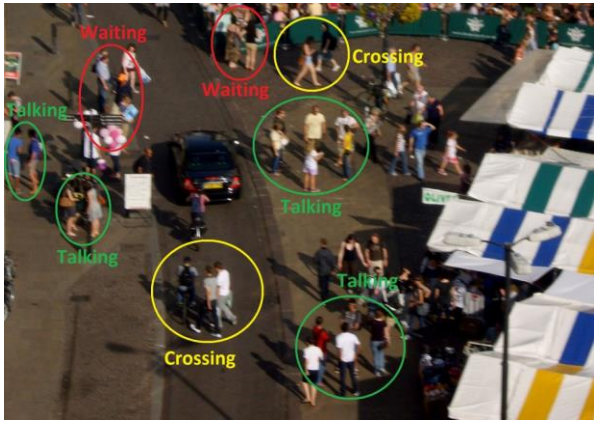


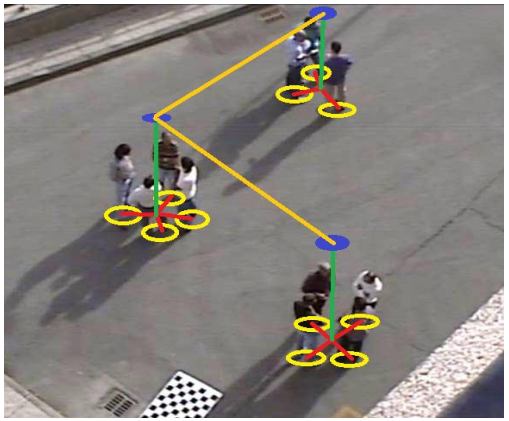


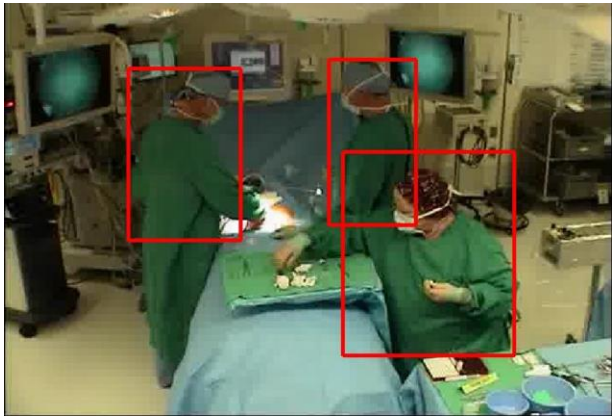


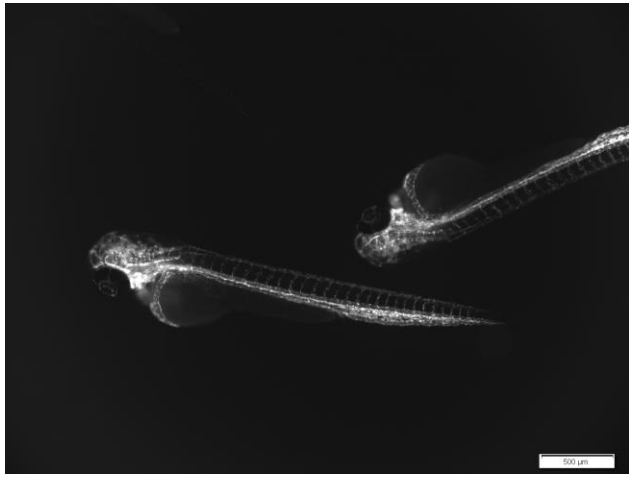
Human (Object) Motion Understanding

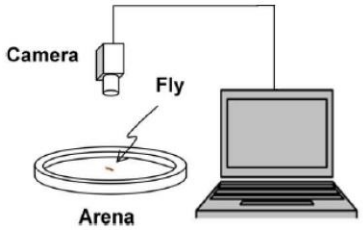






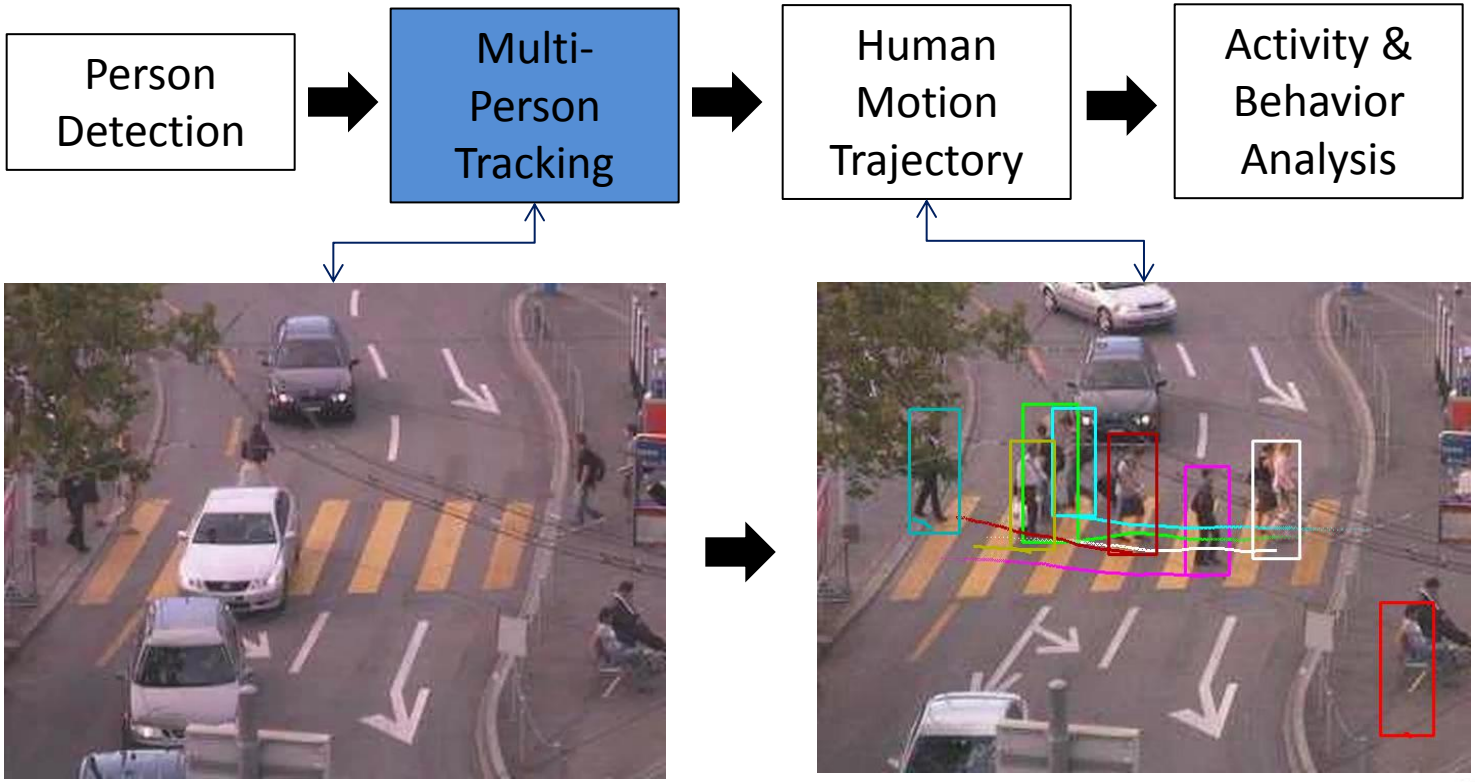






Human Motion: Model to Prediction

- Multi-person tracking provides a consistent inference of the motion of all persons in an image sequence.



Model Local Behavior

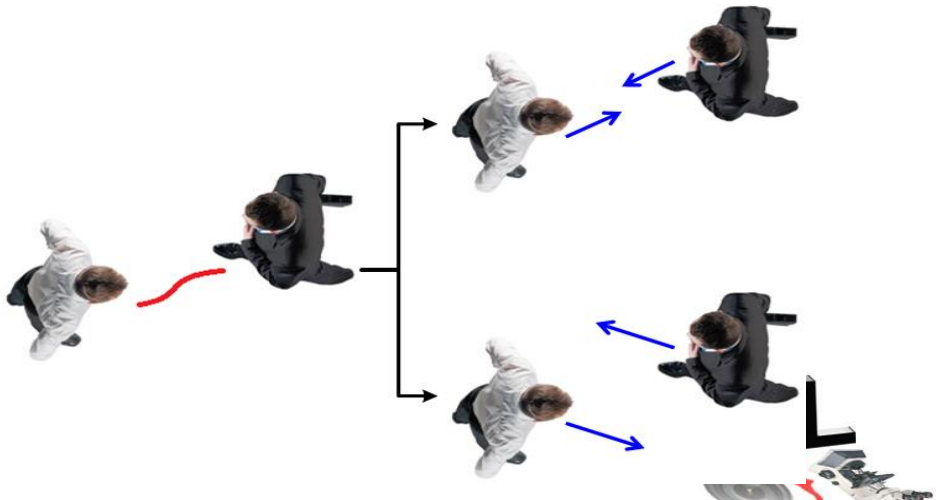
- Model short-term motion through multiple hypothesized **intents**: Repulse or Attract
- The motion of humans can be treated as the sum of attraction and repulsion forces.

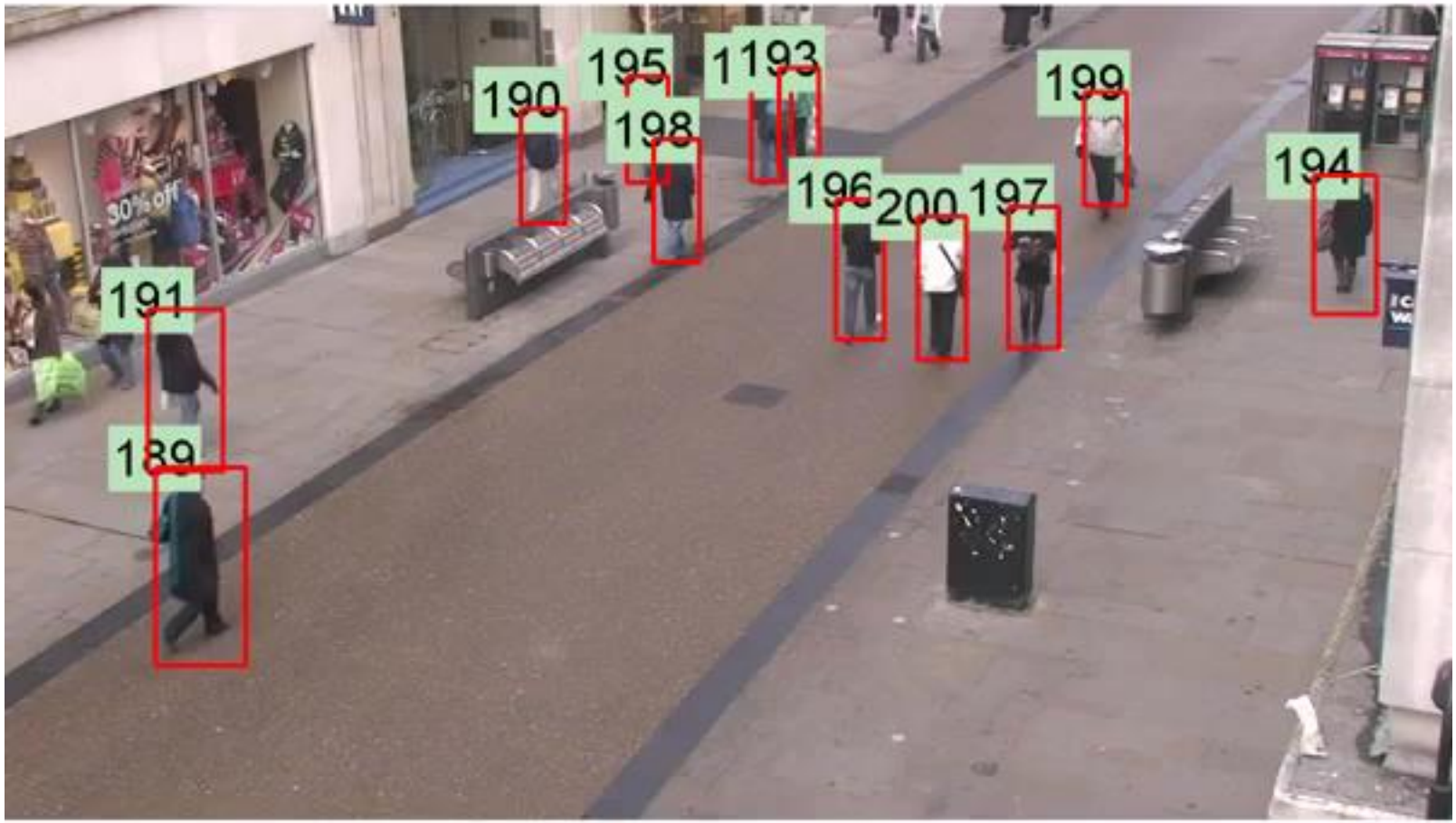
$$\overrightarrow{F}_i = \sum_{j \neq i} \overrightarrow{f}_{ij}^{(repulse)} + \sum_{k \neq i, k \neq j} \overrightarrow{f}_{ik}^{(attract)},$$

- The attraction and avoidance force share the similar mechanics:

$$\overrightarrow{f}_{ij}^{(repulse)} = F^r e^{\left(\frac{r_{i,j} - d_{i,j}}{b}\right)} \vec{u}_{ji}$$

$$\overrightarrow{f}_{ik}^{(attract)} = F^a e^{\left(\frac{r_{i,k} - d_{i,k}}{b}\right)} \vec{u}_{ik}$$

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Challenging Research

- Semantic Scene Labeling
  - Develop methods to segment and annotate imaged scene guided by task specific constraints
- Object Detection
  - Develop generative and discriminative representation models that encode both morphometric and spatial relationships
- Context-aware Object Tracking
  - Develop motion models that integrate spatial context and object interactions
- Activity Recognition
  - Develop generative models for spatio-temporal encoding that can provide discriminative value to identify various human, human-human, and human-object actions