

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, ...



Research Interests

Science

- Statistical Image Analysis
- Learning and Bayesian Inference
- Shape Modeling
- Motion Estimation
- Segmentation / Texture Analysis
- Predictive Filters
- Markov Models

Applications

- Video Surveillance
- Human Activity Analysis
- Human Behavior Understanding
- Biometrics
- Image Cytology and Pathology
- Cancer Diagnostics
- Confocal, Fluorescence, Spectral Microscopy



Human (Object) Motion and Behavior



15th century
studies of
anatomy

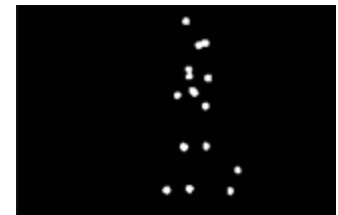


17th century
emergence of
biomechanics



19th century
emergence of
cinematography

1973
studies of human
motion perception

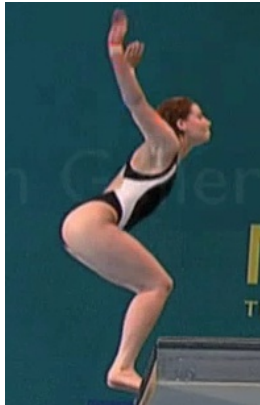


Modern computer vision



Human Activity

- **Human activity is sequence of human action units:**
 - Long jumping: Running -> Jumping -> Landing
- **Human activities are classified as:**
 - Single human activities
 - Human & Object activities
 - Human & Human activities



Diving



Lifting

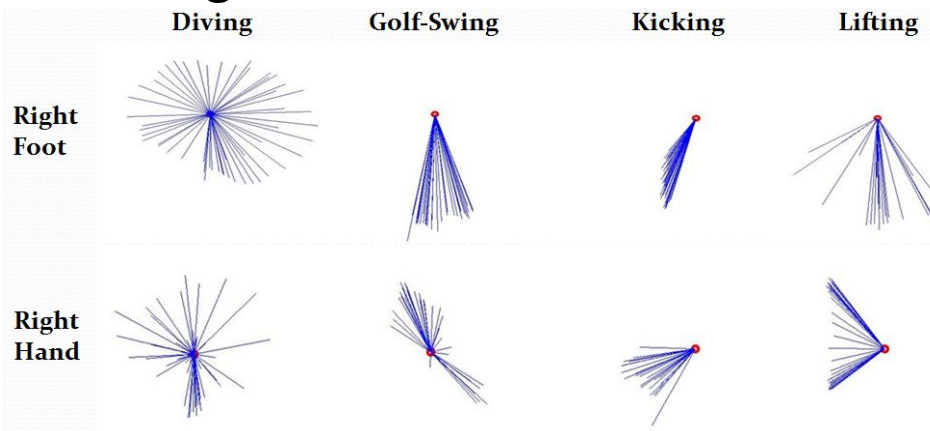


Fighting

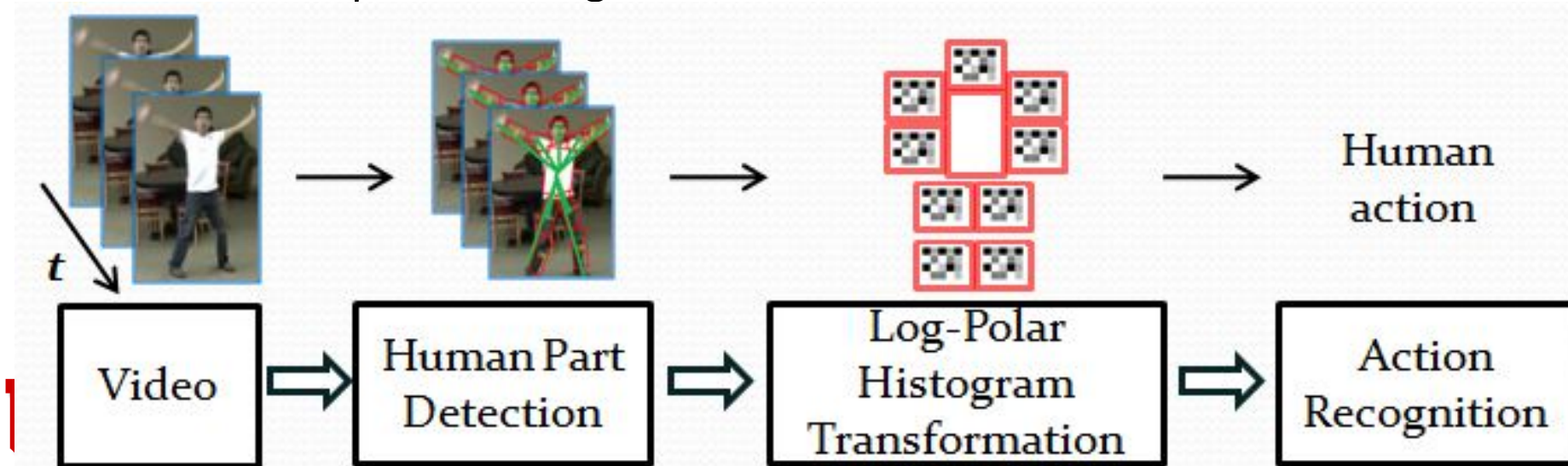


Human Action Representation

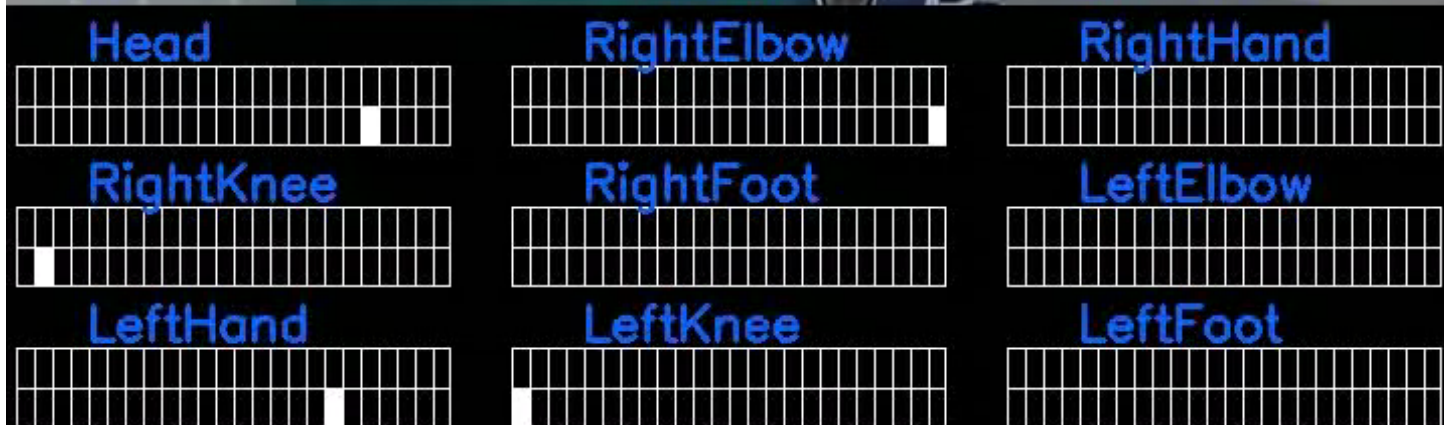
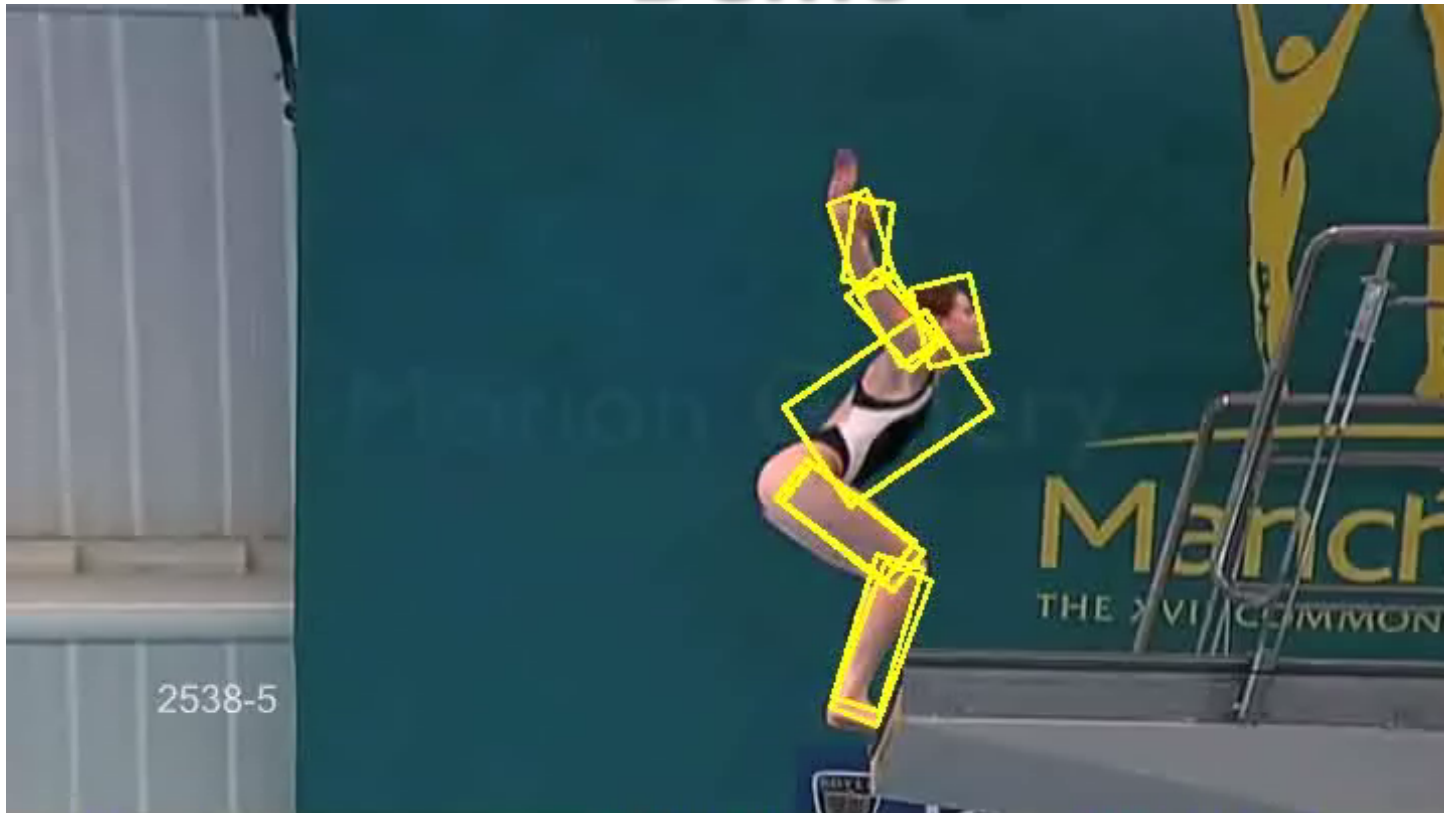
- A collective understanding of human part movements leads to better understanding of human actions.



- Generative representations of the motion of human body part can be developed to recognize actions.



Demo



Group Activity Recognition

- Group Activity
 - a vast number of activities involve multiple people and their interactions.
 - can be described by location and movement of individuals with context information.

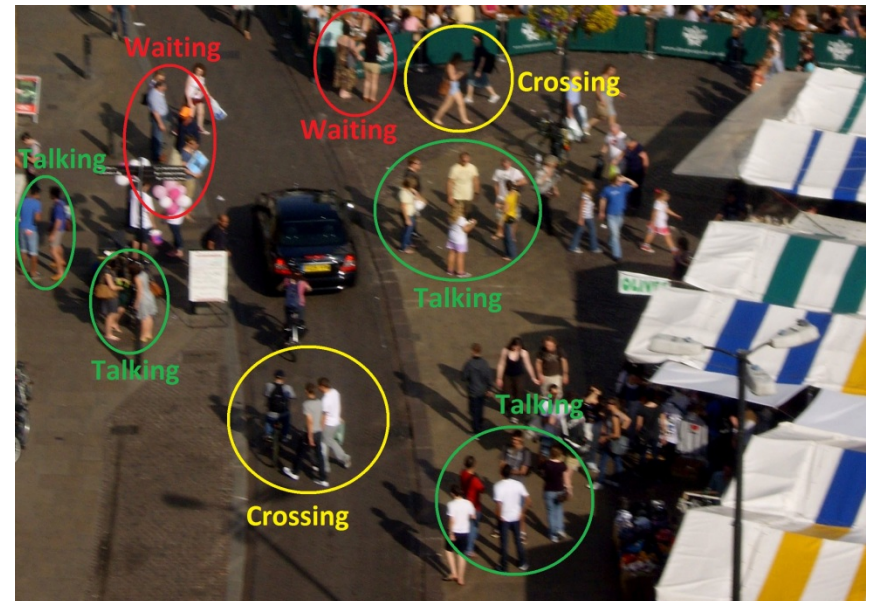
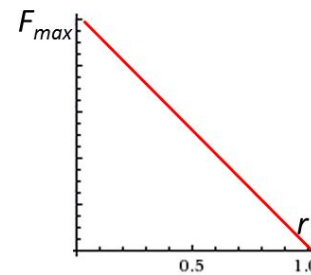
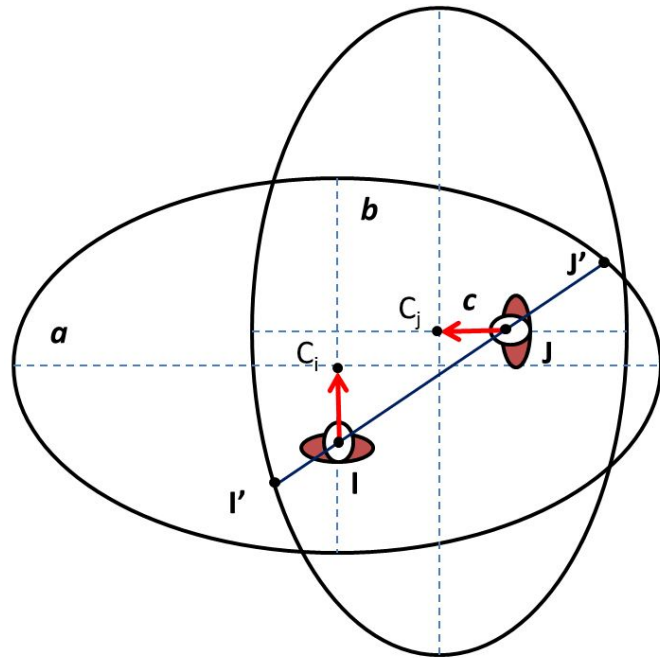
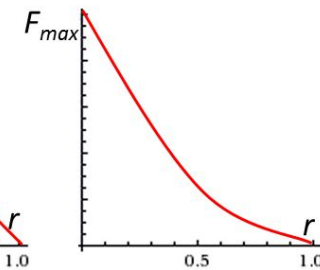


Image from Flickr.com

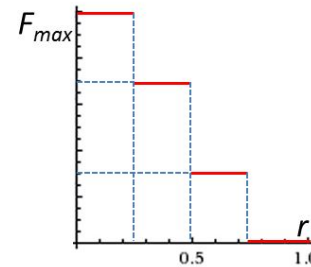
Interaction



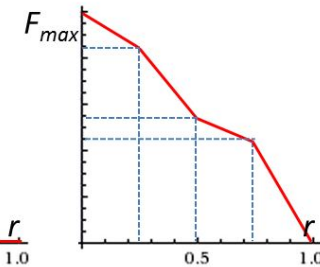
Linear



Power



Step



Polygonal

$$w(i, j) = F_s(r_{ij}) + F_s(r_{ji})$$

$$r_{ij} = \frac{IJ}{IJ'} \text{ and } r_{ji} = \frac{JI}{JI'}$$

where: i and j are 2 persons;
 F_s is the social force; $w(i, j)$
 indicates how 2 persons are
 interacting; ellipse with
 parameters a and b define the
 VFOA for each person



Group Discovery

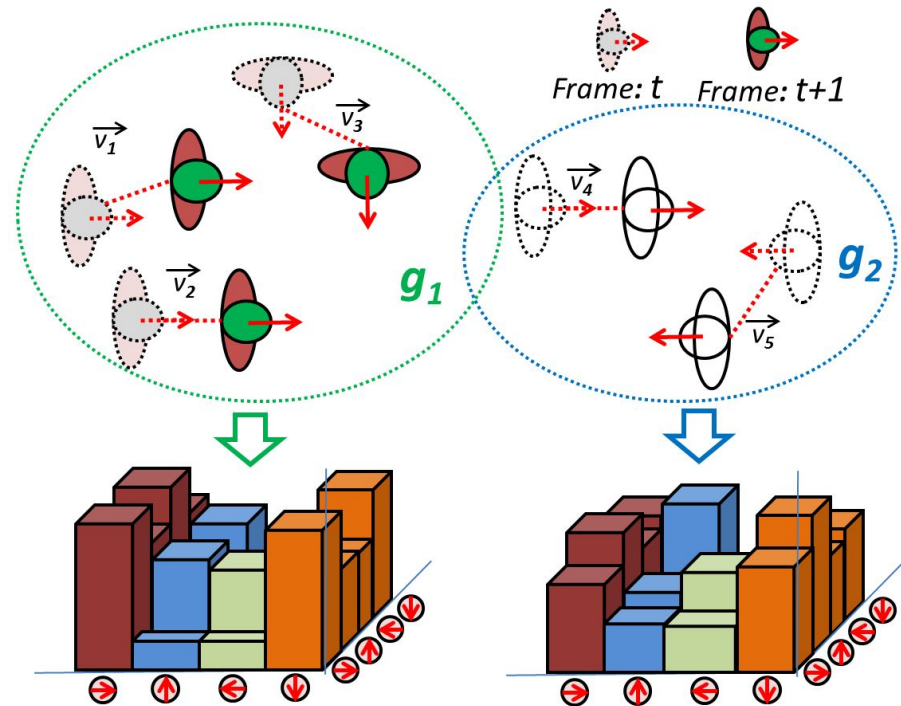
SEQ. 1



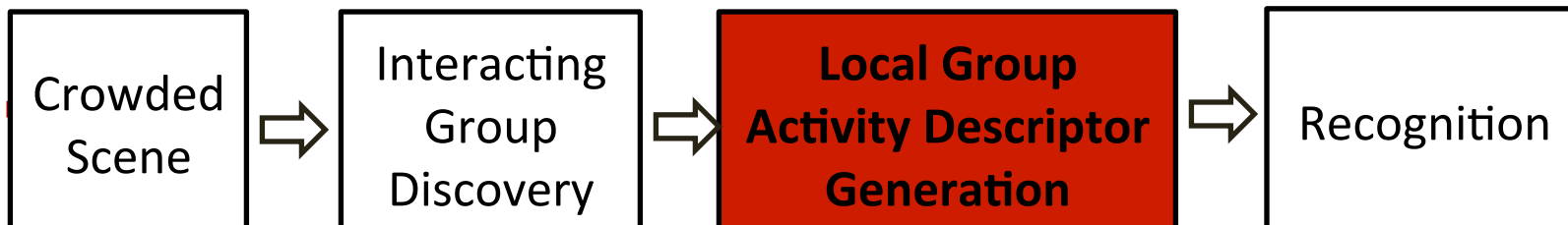
Group Activity Descriptor

Incorporate motion and interaction information

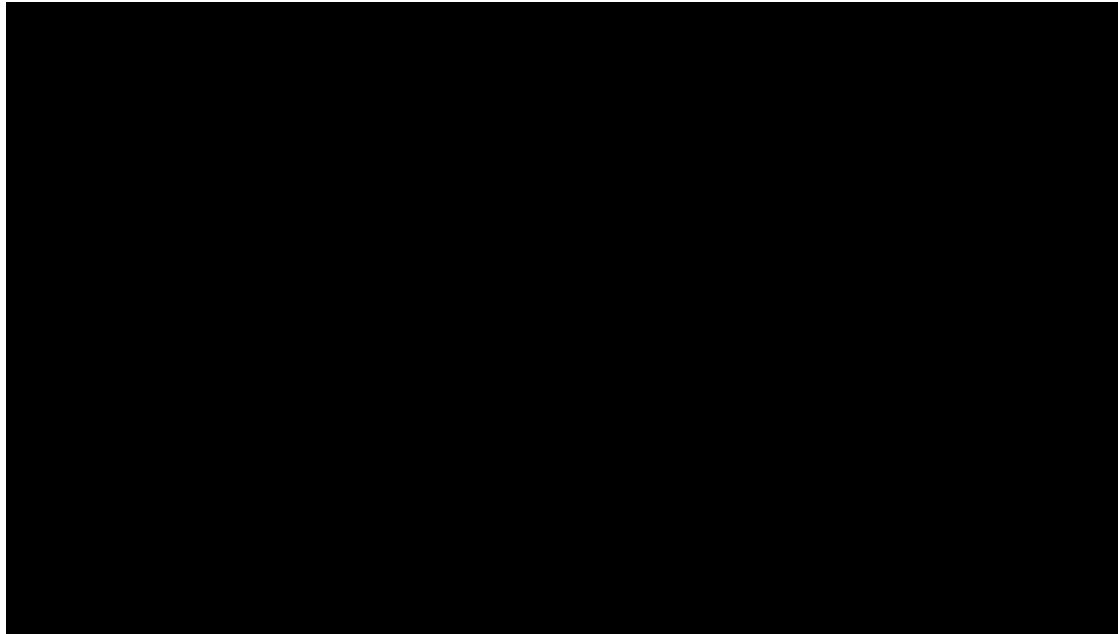
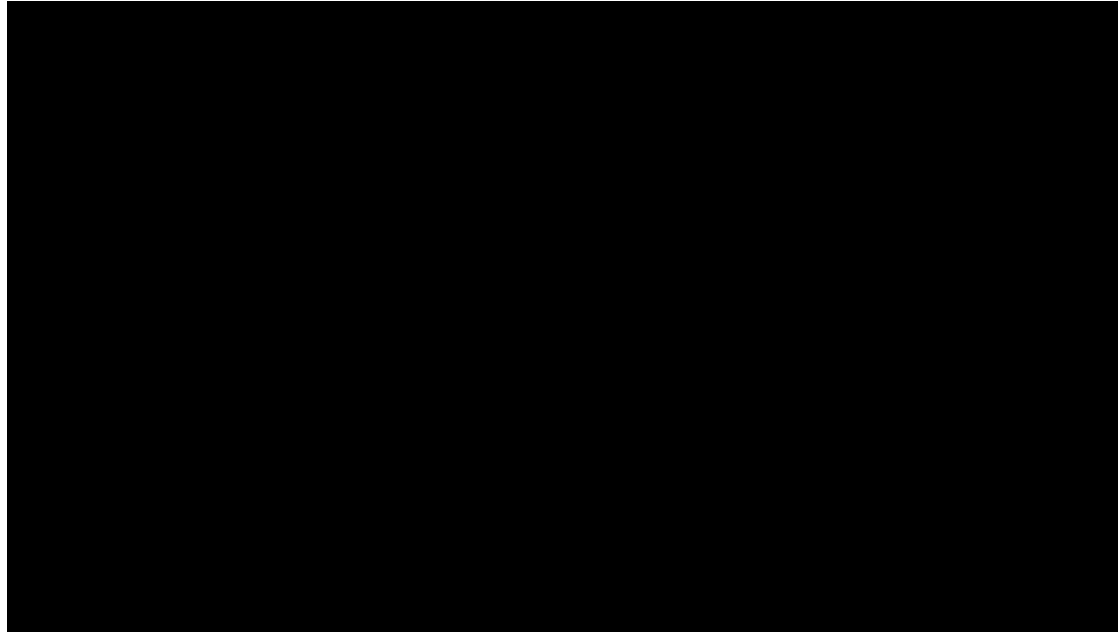
- \vec{v} captures movements of people
- P captures pose distribution of people in group



$$LGA(m, n) = \sum_{i, j \in N_k, p_i = m, p_j = n} w(i, j) |\vec{V}_i| |\vec{V}_j|$$



Group Activity



Thank You

Collaborators

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