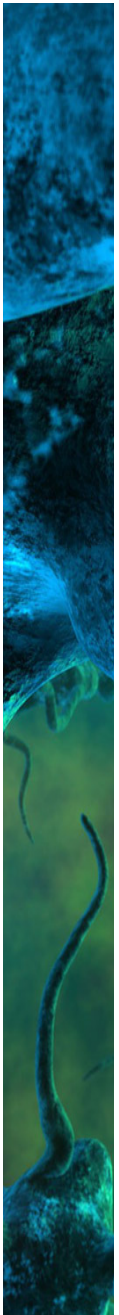
The background of the slide is an abstract, high-contrast image with a blue and green color palette. It features complex, branching, and textured shapes that resemble biological structures like neurons or coral, or perhaps a complex network graph. The lighting is dramatic, with bright highlights and deep shadows.

Classification of Graph Sequences Utilizing the Eigenvalues of the Distance Matrices and Hidden Markov Model

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Classification Task

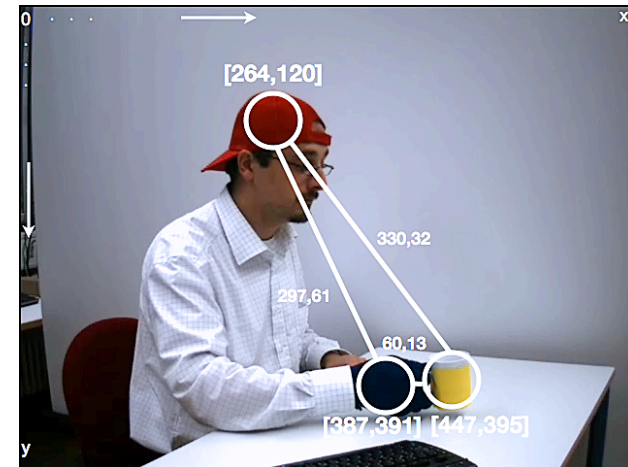
- Classification of human activities based on sequences of camera images.
- 289 video clips
- Length between one and eight seconds
- Resolution: 356 x 474 pixels
- Frame rate: 24 fps
- A male person is recorded, sitting at a table, acting different action classes.
- Every sequence belongs to one of the three classes:
 - Person **drinks** out of the cup.
 - Person **moves** the cup on the table.
 - Person **scratches** his head.



Graph and Feature Extraction

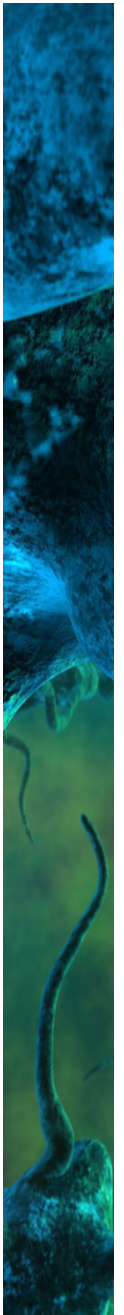
For each single image:

- Locations of the person's body parts (hand, head) and objects (cup) have to be estimated.
- Objects refer to the nodes of a graph.
- Euclidean distances between all pairs of detected objects are computed: $d(i, j) \forall i, j \in \text{nodes}$
- Nodes labeled with the coordinates, edges with the Euclidean distances between the adjacent nodes.



- Computation of the eigenvalues of the weighted adjacency matrix \mathbf{A} with $a_{ij} = d(i, j)$ for $i \neq j$ and $a_{ij} = 0$ for $i = j$.
- Computation of the eigenvalues of the extension \mathbf{A}^+ with $a_{ij}^+ = a_{ij}$ for $i \neq j$ and $a_{ij}^+ = \sum_k d(i, k)$ for $i = j$.

The spectra (one spectrum taken from one single image) are forming a sequence, which serves as the input to Gaussian mixture models (GMMs), which are utilized to estimate the emission probabilities of hidden Markov models (HMMs).



Experiments

Settings of the HMMs and GMMs:

- 3 HMMs: The probability $P(O|\lambda_i)$, $i=1,\dots,3$, that the HMM λ_i generated the test sequence O , was estimated with the forward algorithm. The maximum of the three achieved values $P(O|\lambda_i)$ leads to the most likely class.
- Verification of the number of states in each HMM and the number of Gaussian distributions in each state.
- Fully connected models and left-right models were tested.
- Full and diagonal covariance matrices were tested.

Classification experiments:

- Investigation of the temporal development of the eigenvalues.
- How many eigenvalues are necessary to get still satisfying classification rates?
- What happens, if a second cup stands on the table and/or a second person is sitting at the table (more objects and different number of nodes)?

For the answers and a more detailed discussion, meet me at my poster no.7!

