Script generated by TTT

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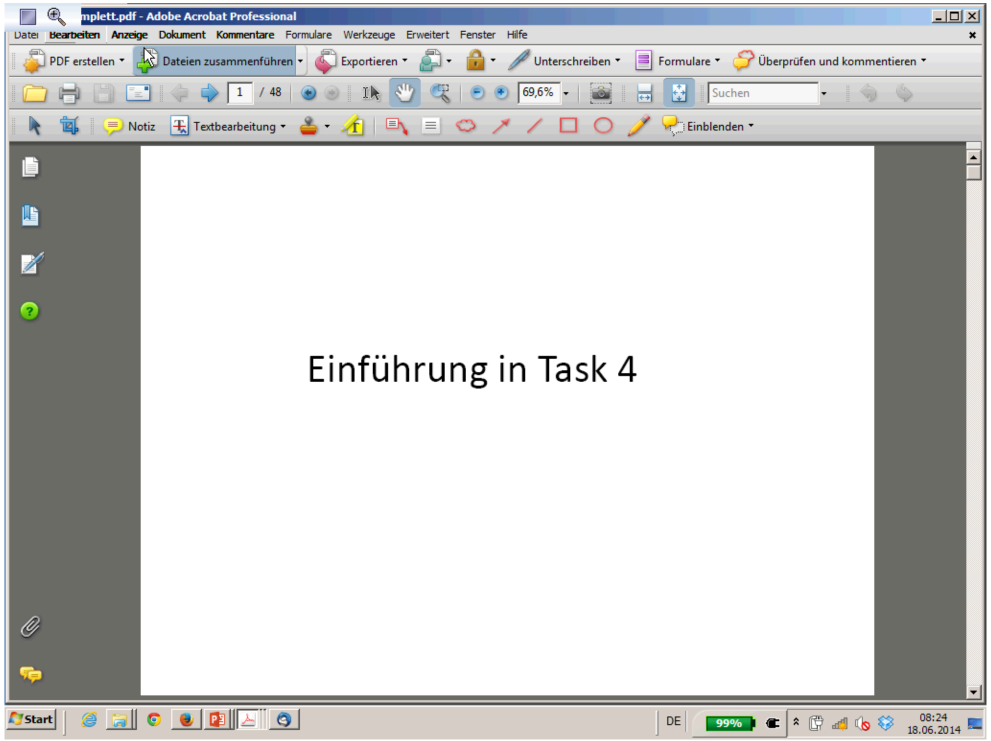

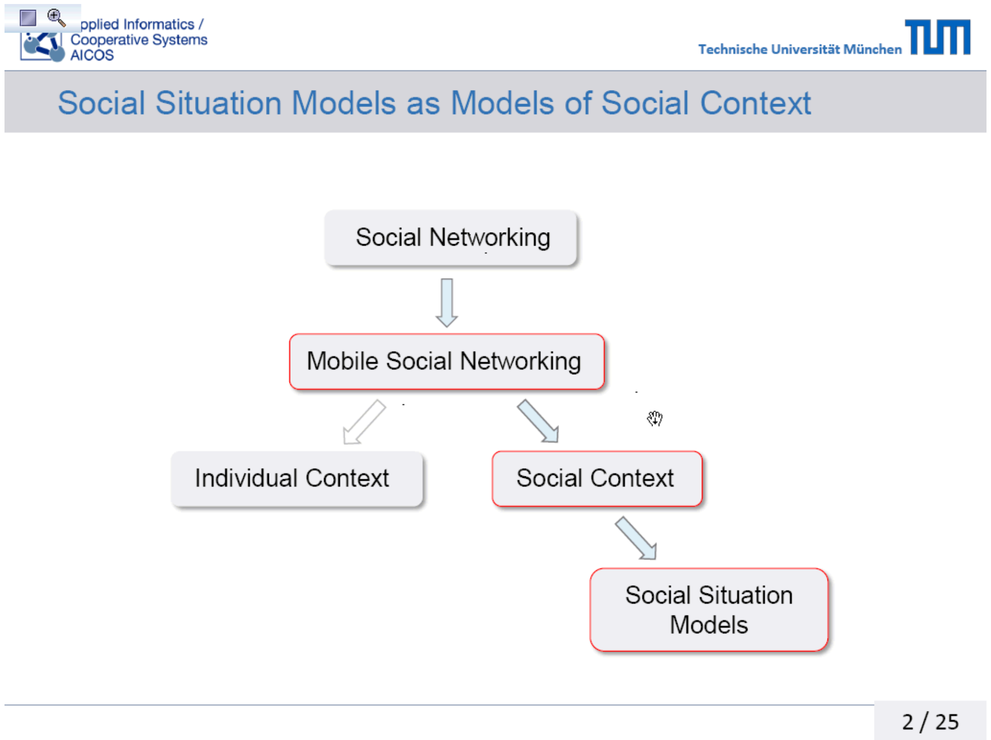

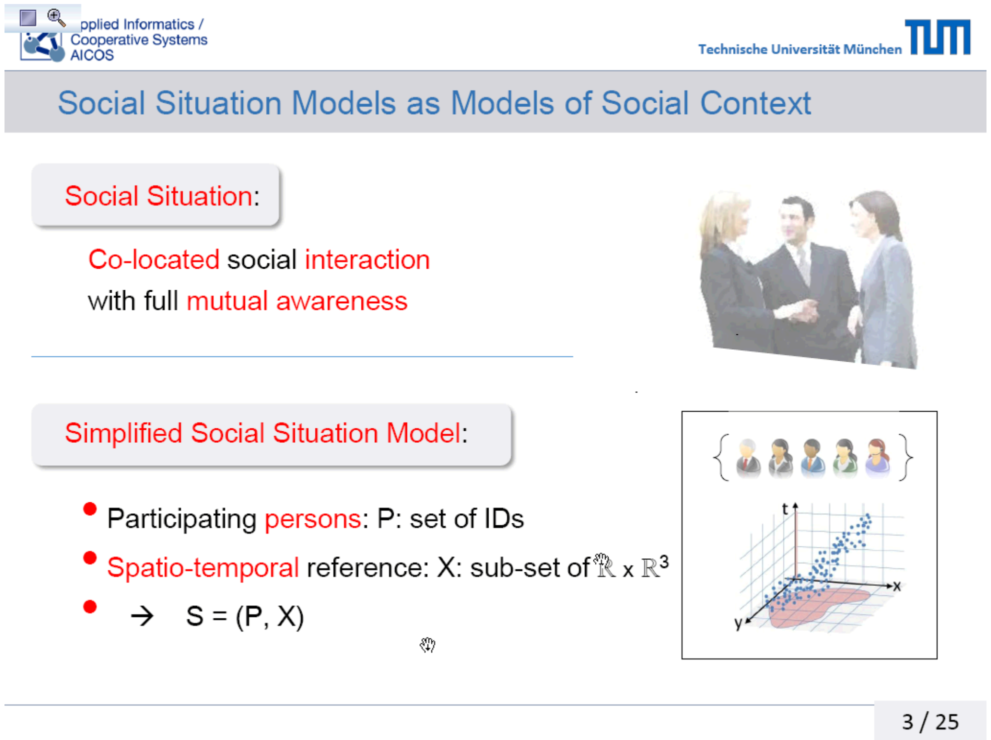

Social Situation Models and Agents

Social Networking

Mobile Social Networking

Decentralized Social Networking

Personal SN Agents

Individual Context

Social Context

Social Situation Models

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Social Situation Models

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Research Questions

- Method for measuring human social interaction geometry (mobile → live ; experiment → sociology model)
- General, quantitative, algorithmically processable model for human social interaction geometry
- Use of model to detect Social Situations (e.g. from mobile device measurements)
- Use as social context for applications maintaining privacy

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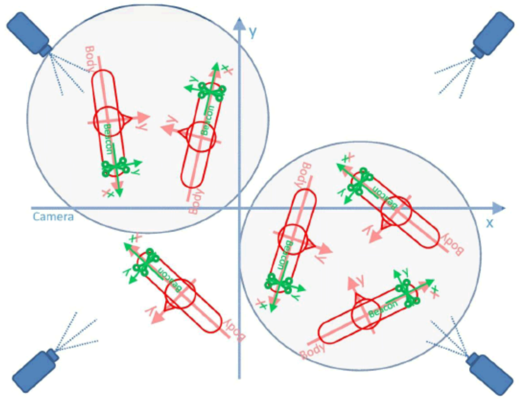
Experiment



Results

Experiment data: Manual annotation

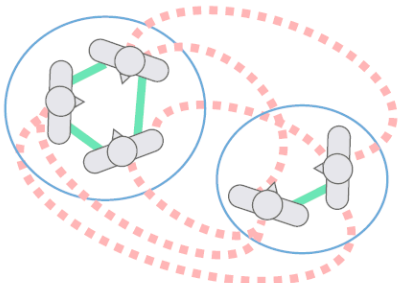
$|S^{\oplus}| = 321307\ (\delta\theta,\ \delta d)$ pairs corresponding to „in a social situation“

$|S^{\ominus}| = 398335\ (\delta\theta,\ \delta d)$ pairs corresponding to „not in a social situation“

Example:

$|S^{\oplus}| = 4$

$|S^{\ominus}| = 6$



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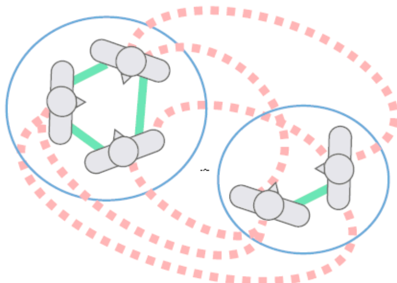

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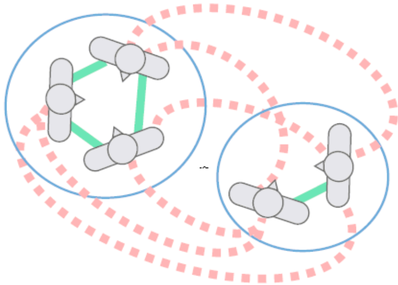

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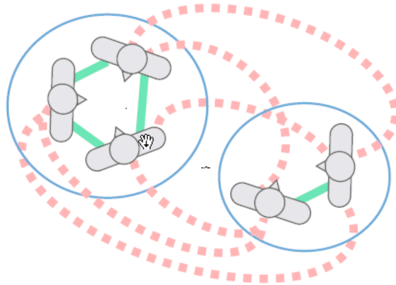

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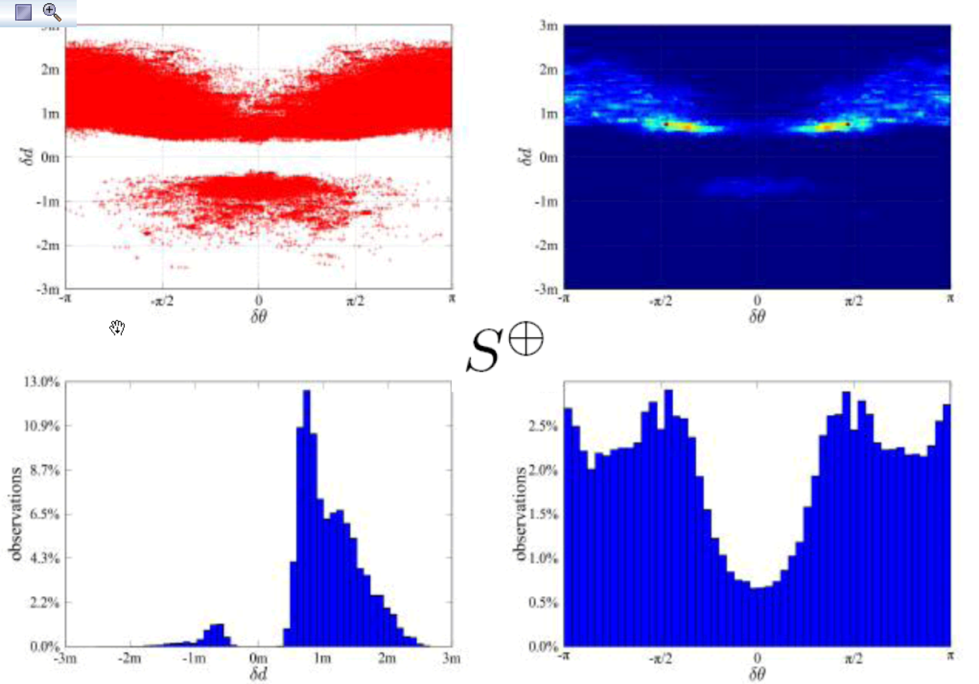

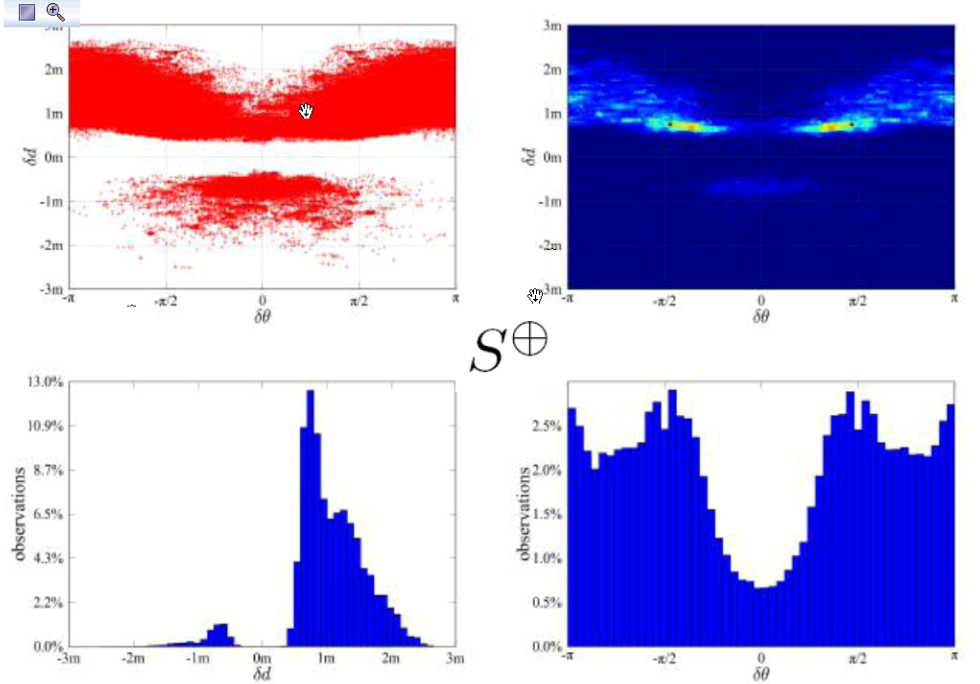

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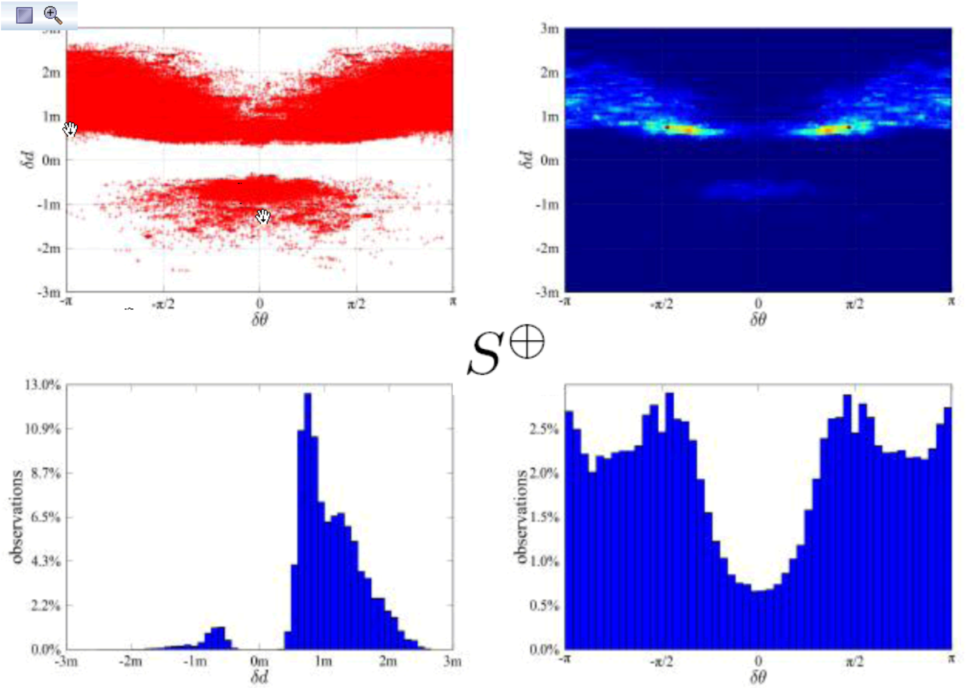
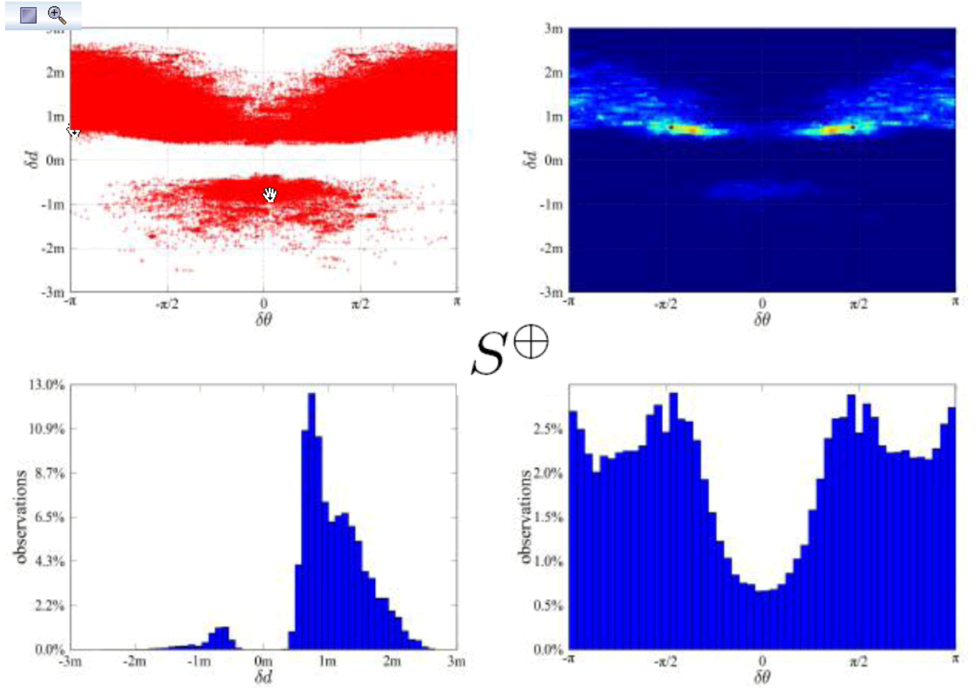

$S^{\oplus}$
δd
δθ
observations
3m
2m
1m
0m
-1m
-2m
-3m
-π
-π/2
0
π/2
π
13.0%
10.9%
8.7%
6.5%
4.3%
2.2%
0.0%
2.5%
2.0%
1.5%
1.0%
0.5%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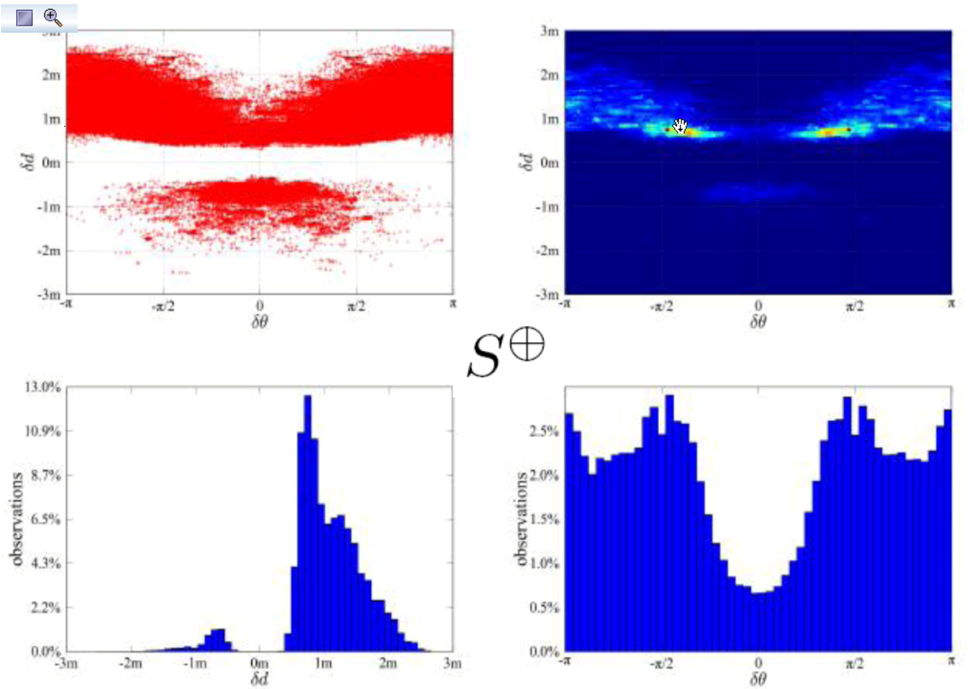
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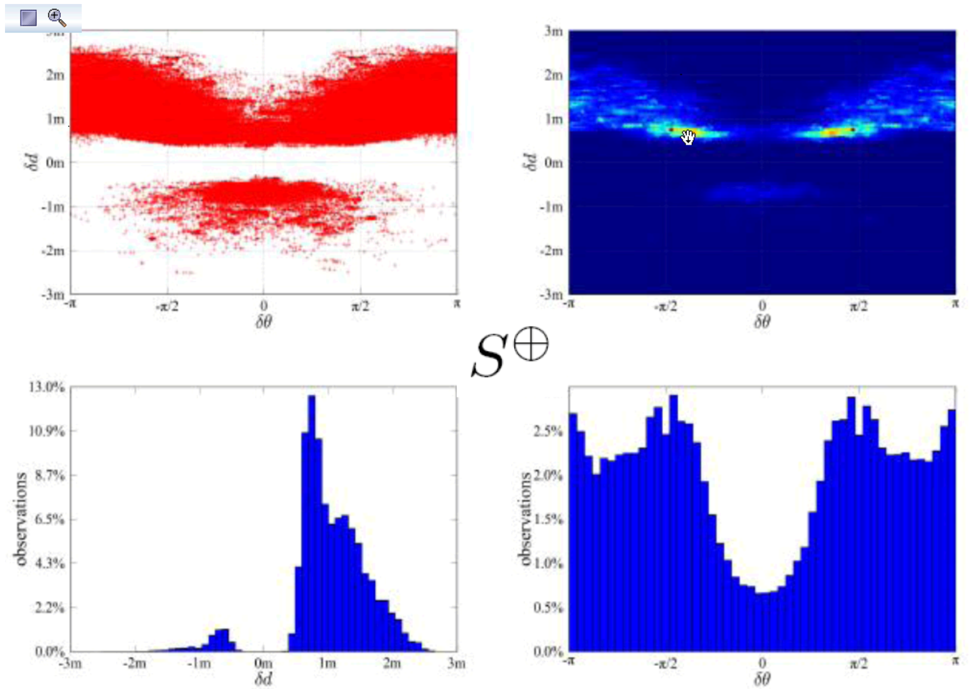
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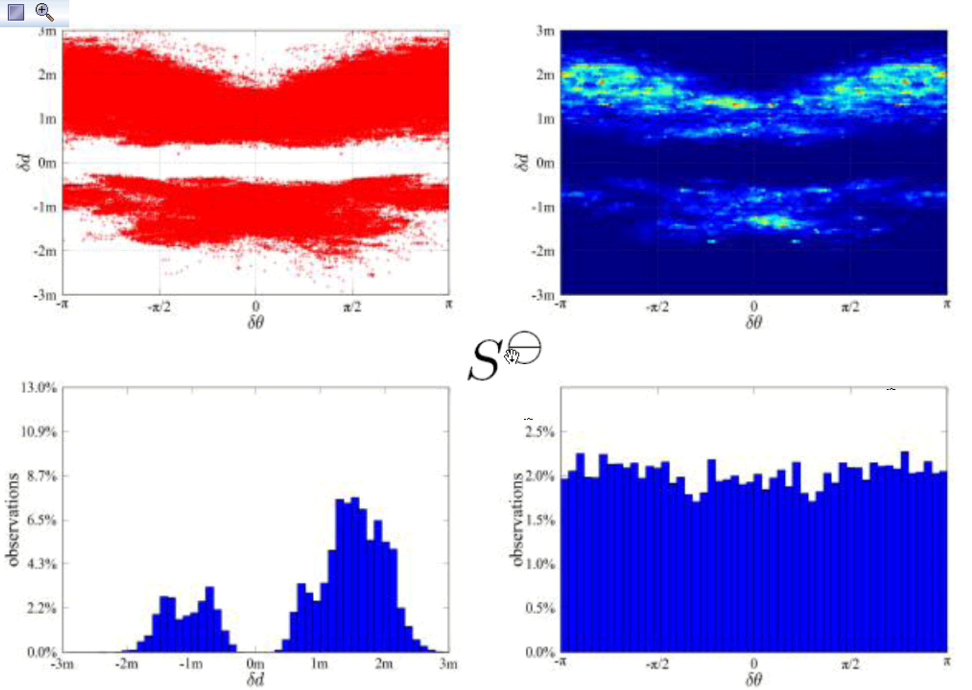
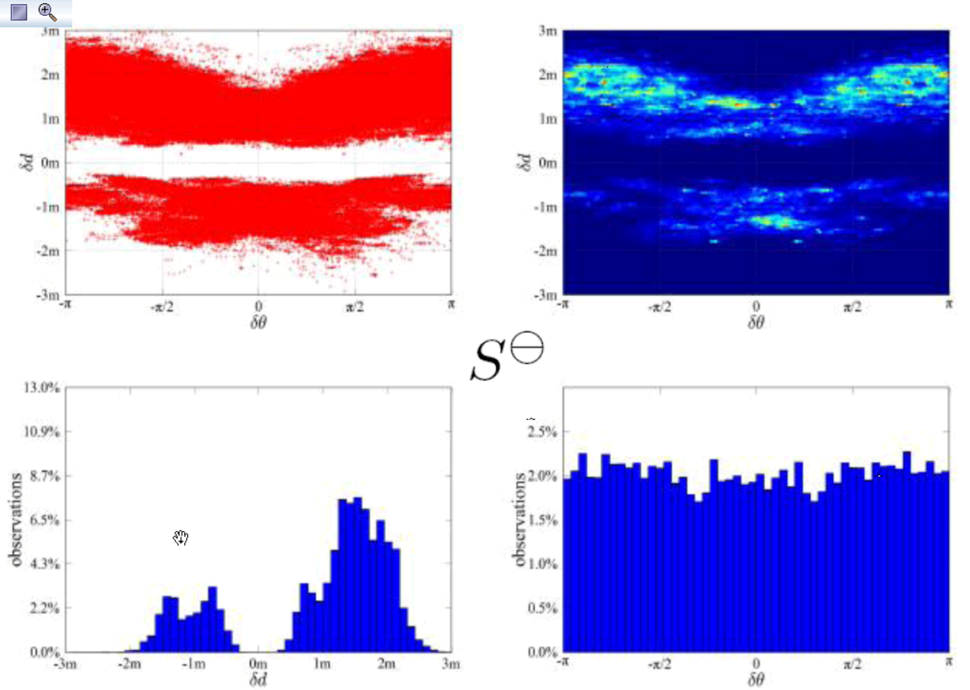
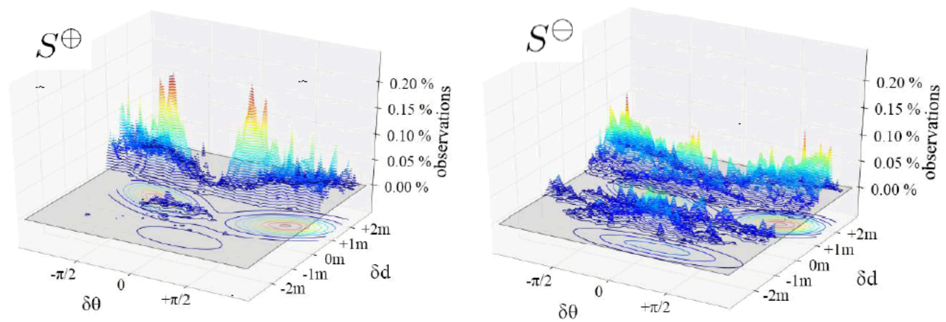




Results

$S^{\oplus}$ = { $(\delta\theta, \delta d)$ } pairs in a social situation
$S^{\ominus}$ = { $(\delta\theta, \delta d)$ } pairs not in a social situation

→ train (EM-algorithm) one Gaussian Mixture Model for $S^{\oplus}$ and one for $S^{\ominus}$
→ $p^{\oplus}(\delta\theta, \delta d)$ and $p^{\ominus}(\delta\theta, \delta d)$



Classification Results

Classifier	Accuracy*
Gaussian Mixture Model (3 Gaussians)	74,34 %
Gaussian Mixture Model (5 Gaussians)	74,67 %
Gaussian Mixture Model (7 Gaussians)	74,59 %
Naive Bayes	65,45 %
Support Vector Machine (Polyn. Kernel)	77,81 %

(*) w. 10-fold cross validation

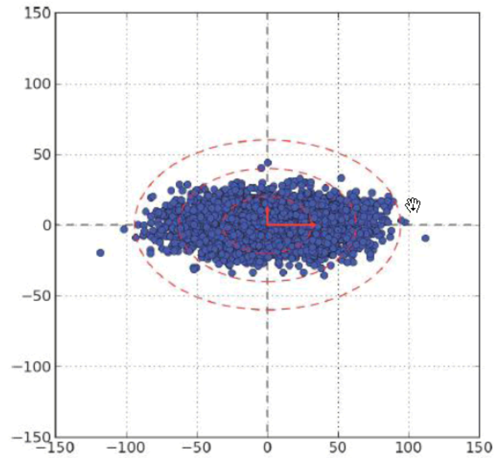
Preprocessing

- Two-dimensional images correspond to one-dimensional vectors

			0.47
0.99	0.97	...	0.24
...	...	...	...

0.12	0.8	...	0.47	0.99	0.97	...

Example



Derivation

- Eigenvalue decomposition of the covariance matrix

$$C = E\Lambda E^T = \begin{pmatrix} e_{11} & \cdots & e_{1n} \\ \vdots & \ddots & \vdots \\ e_{m1} & \cdots & e_{mn} \end{pmatrix} \begin{pmatrix} \lambda_1 & & 0 \\ & \ddots & \\ 0 & & \lambda_n \end{pmatrix} \begin{pmatrix} e_{11} & \cdots & e_{m1} \\ \vdots & \ddots & \vdots \\ e_{1n} & \cdots & e_{mn} \end{pmatrix}$$

  where the columns of E denote the eigenvectors of C and each λ the respective eigenvalue

- In case of PCA, the principal components are the ones associated with the highest eigenvalues, hence

$$|\lambda_1| > |\lambda_2| > \ldots > |\lambda_n|$$

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Preprocessing

- Concatenation of the N_p images for each person p yields the final training dataset

$$X = \begin{pmatrix} i_{1_1} & i_{2_1} & \cdots & i_{N_1} \\ i_{1_2} & i_{2_2} & \cdots & i_{N_2} \\ \vdots & \vdots & \ddots & \vdots \\ i_{1_d} & i_{2_d} & \cdots & i_{N_d} \end{pmatrix}$$

  where i_{j_k} denotes the k-th component of the j-th image (now represented as d-dimensional vectors) and $N = \sum_{p \in P} N_p$

- A second data structure is mandatory to store the assignment of column indexes to persons

Eigenfaces

- Next, PCA is used to determine the set of eigenfaces (typically ~40) that are best fit to reconstruct the training data
- Beware:
  A 92x112 image yields a 10304-dimensional vector.
- How can we deal with the eigenvalue decomposition of a 10304x10304 covariance matrix?
- Actually only ~40 eigenpairs need to be computed!

Eigenfaces

- Reconsider the general form of the eigenvalue equation

$$\Sigma' x = \lambda x$$

- Substitute $X^T X$ for Σ'

$$X^T X x = \lambda x$$

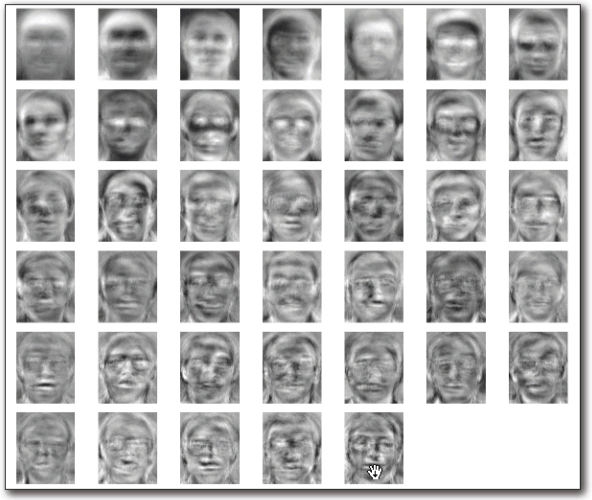
- Multiply the above equation with X

$$X X^T X x = \lambda X x$$

- Substitute Σ for $X X^T$

$$\Sigma X x = \lambda X x$$

Eigenfaces



Task 2: Face Recognition

main To Dos:

- built a database of face-images and detect faces with the help of Open-CV (given C++ class)
- understand and implement Principal Component Analysis
- implement a KNN classifier
- apply and test your implementation to the test-database.