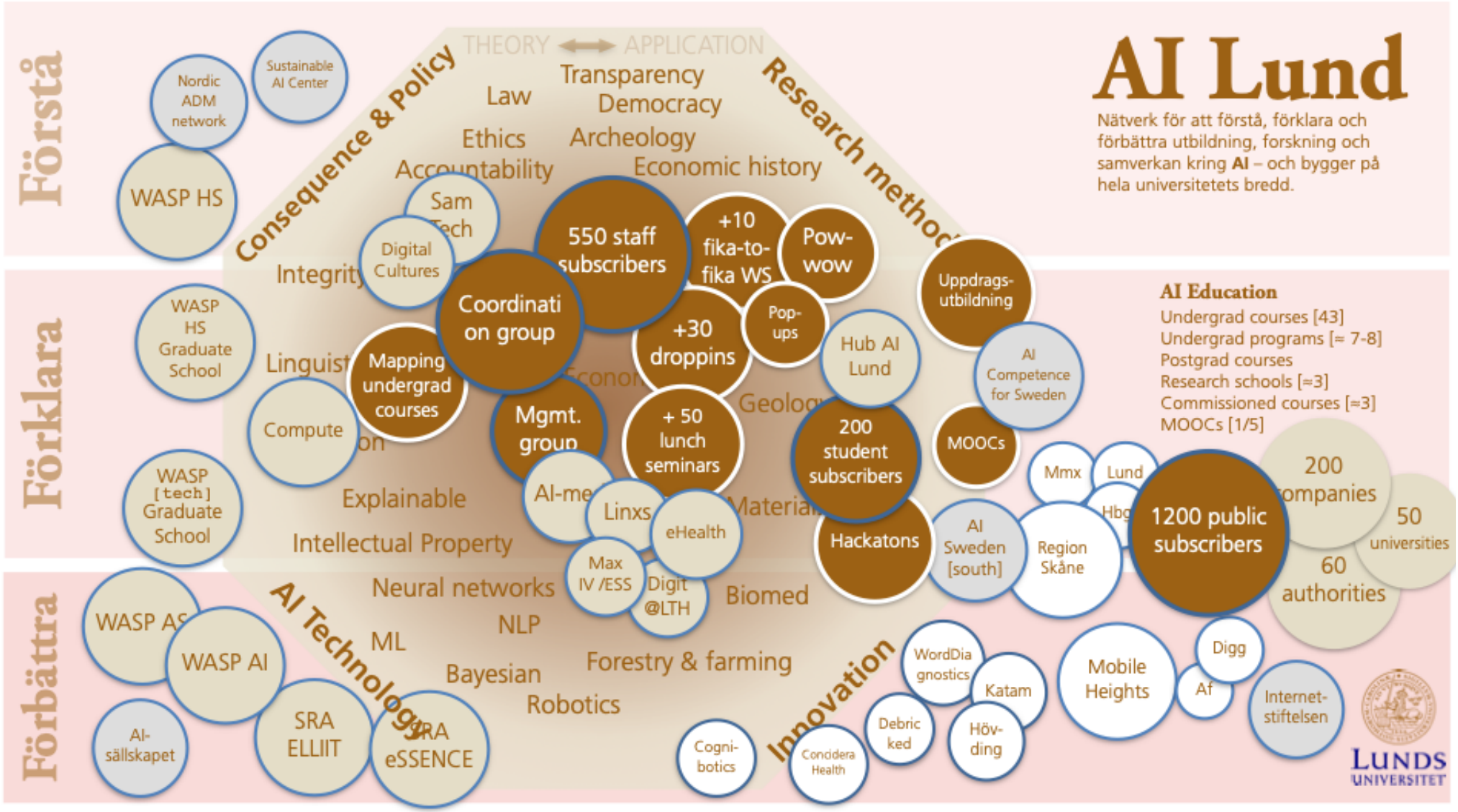
Visualisation and Analysis using AI

KALLE ÅSTRÖM

Visualisation and Analysis using AI

- AI Lund
- Analysis and Visualization
- Dimensionality reduction
- Visualizing our physical world


Förstå
Förklara
Förbättra
AI Lund
Nätverk för att förstå, förklara och förbättra utbildning, forskning och samverkan kring AI – och bygger på hela universitetets bredd.
THEORY
APPLICATION
Consequence & Policy
Research method
AI Technology
Innovation
Law
Transparency
Democracy
Ethics
Archeology
Accountability
Economic history
Integrity
Linguist
Geology
Explainable
Intellectual Property
Neural networks
NLP
ML
Bayesian
Forestry & farming
Robotics
Biomed
Nordic ADM network
Sustainable AI Center
WASP HS
Sam Tech
Digital Cultures
550 staff subscribers
+10 fika-to-fika WS
Pow-wow
Coordination group
+30 droppins
Pop-ups
Mapping undergrad courses
Mgmt. group
+ 50 lunch seminars
Hub AI Lund
Uppdrags-utbildning
AI Competence for Sweden
200 student subscribers
MOOCs
Hackatons
WASP HS Graduate School
Compute
WASP [tech] Graduate School
AI-me
Linxs
eHealth
Max IV /ESS
Digit @LTH
WASP AS
WASP AI
AI-sällskapet
SRA ELLIT
SRA eSSENCE
Cogni-botics
Concidera Health
Debric ked
Höv-ding
WordDiagnostics
Katam
Mobile Heights
Digg
Af
Internet-stiftelsen
AI Sweden [south]
Region Skåne
Mmx
Lund
Hbg
1200 public subscribers
200 companies
50 universities
60 authorities
AI Education
Undergrad courses [43]
Undergrad programs [≈ 7-8]
Postgrad courses
Research schools [≈3]
Commissioned courses [≈3]
MOOCs [1/5]
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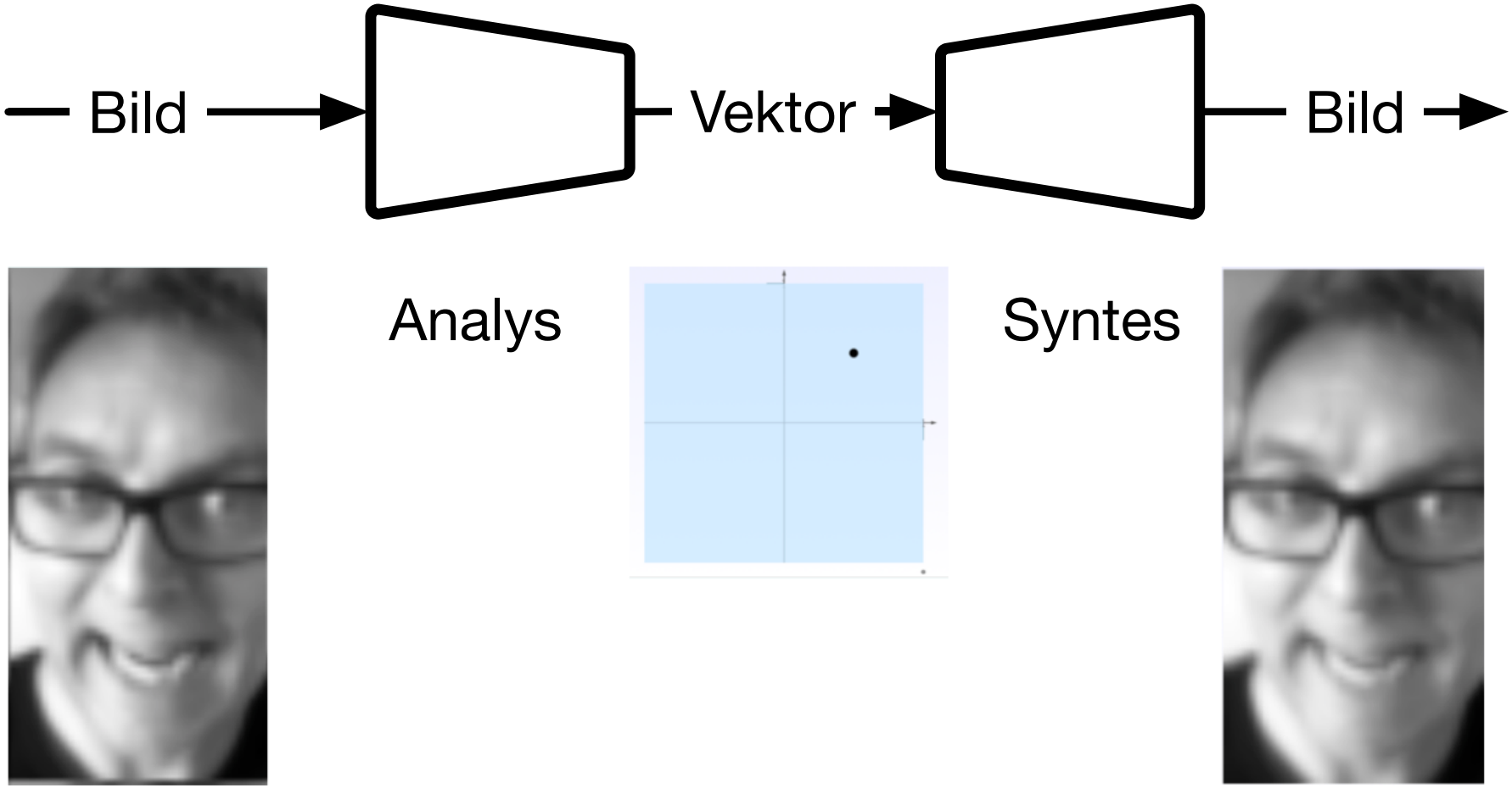
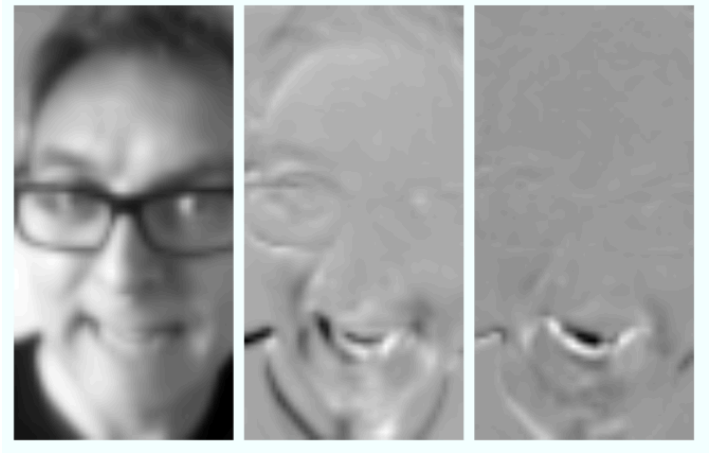
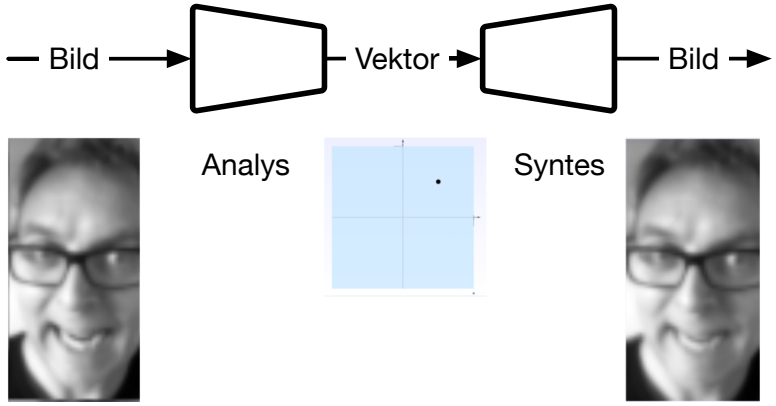
AI for analysis and synthesis
Dimensionality reduction

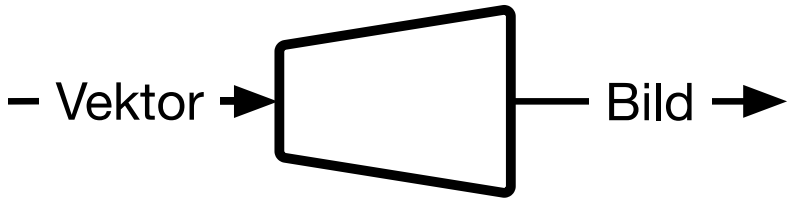


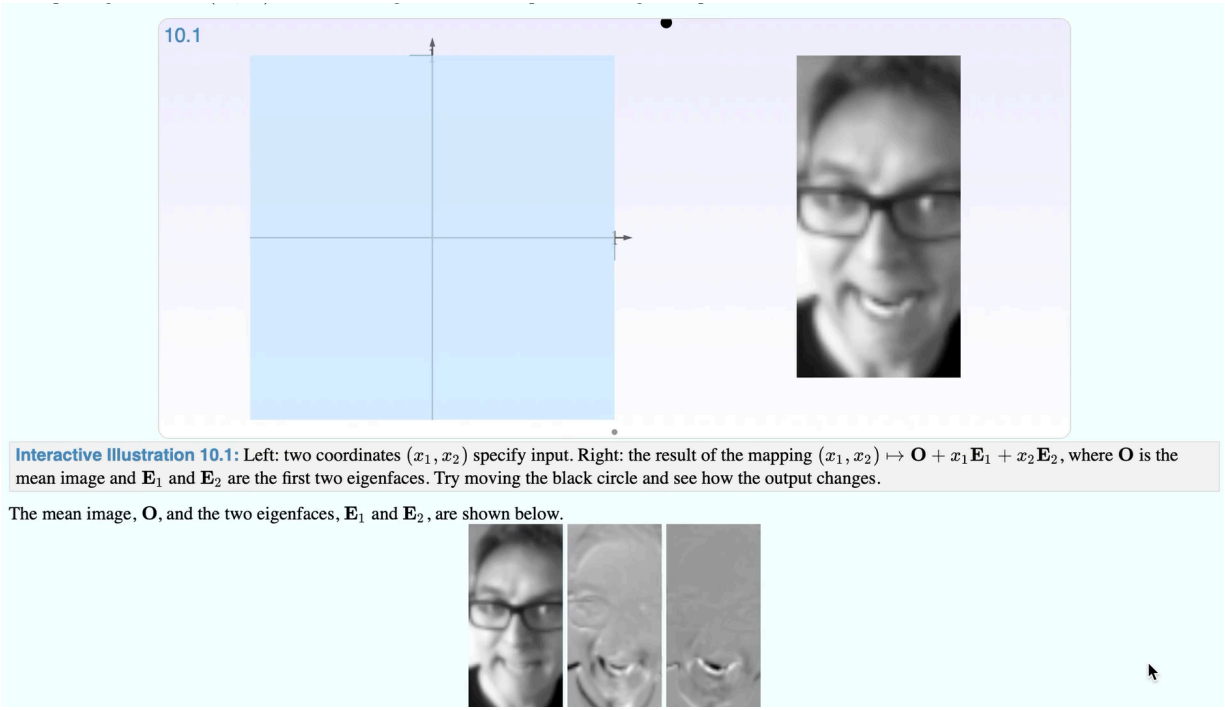
AI for analysis and synthesis
Dimensionality reduction





AI for analysis and synthesis
Dimensionality reduction



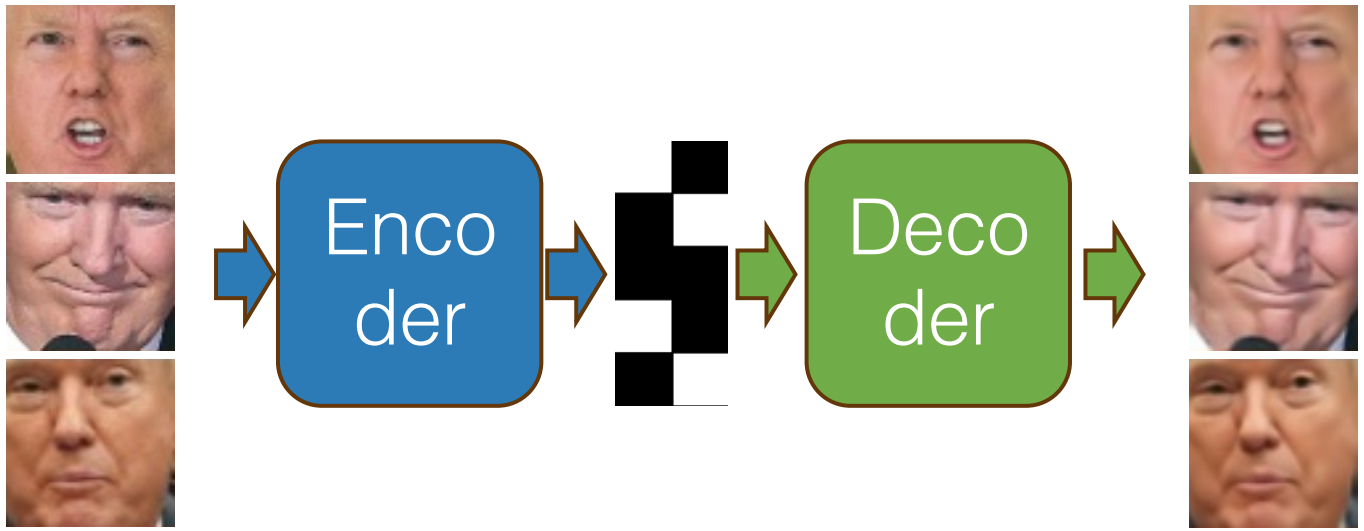


Interactive Illustration 10.1: Left: two coordinates (x_1, x_2) specify input. Right: the result of the mapping $(x_1, x_2) \mapsto \mathbf{O} + x_1\mathbf{E}_1 + x_2\mathbf{E}_2$, where $\mathbf{O}$ is the mean image and $\mathbf{E}_1$ and $\mathbf{E}_2$ are the first two eigenfaces. Try moving the black circle and see how the output changes.

The mean image, $\mathbf{O}$, and the two eigenfaces, $\mathbf{E}_1$ and $\mathbf{E}_2$, are shown below.

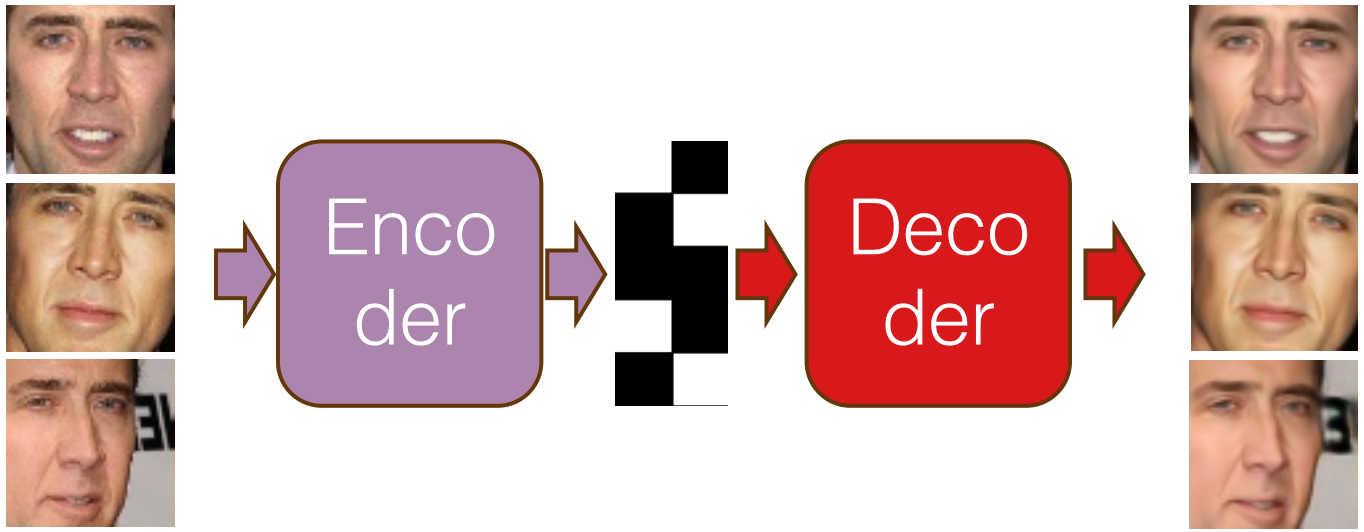
Autoencoder

- Face to Face transfer using Autoencoder
  - Several training examples, varying pose/expression/lightning etc



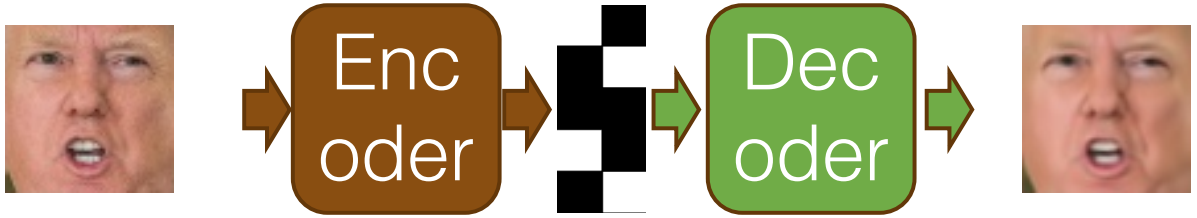
Autoencoder

- Face to Face transfer using Autoencoder
  - Another person

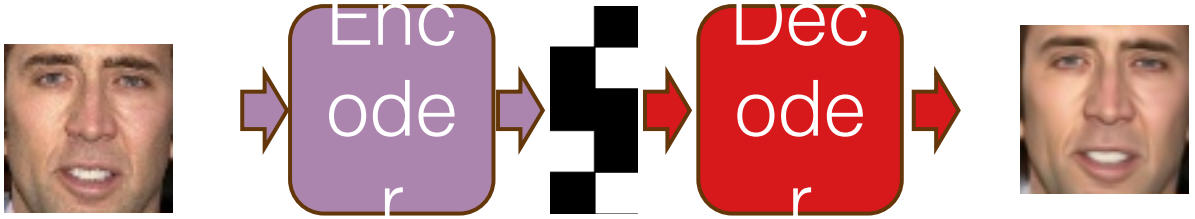


Autoencoder

- Two seperate Autoencoders
- Person A

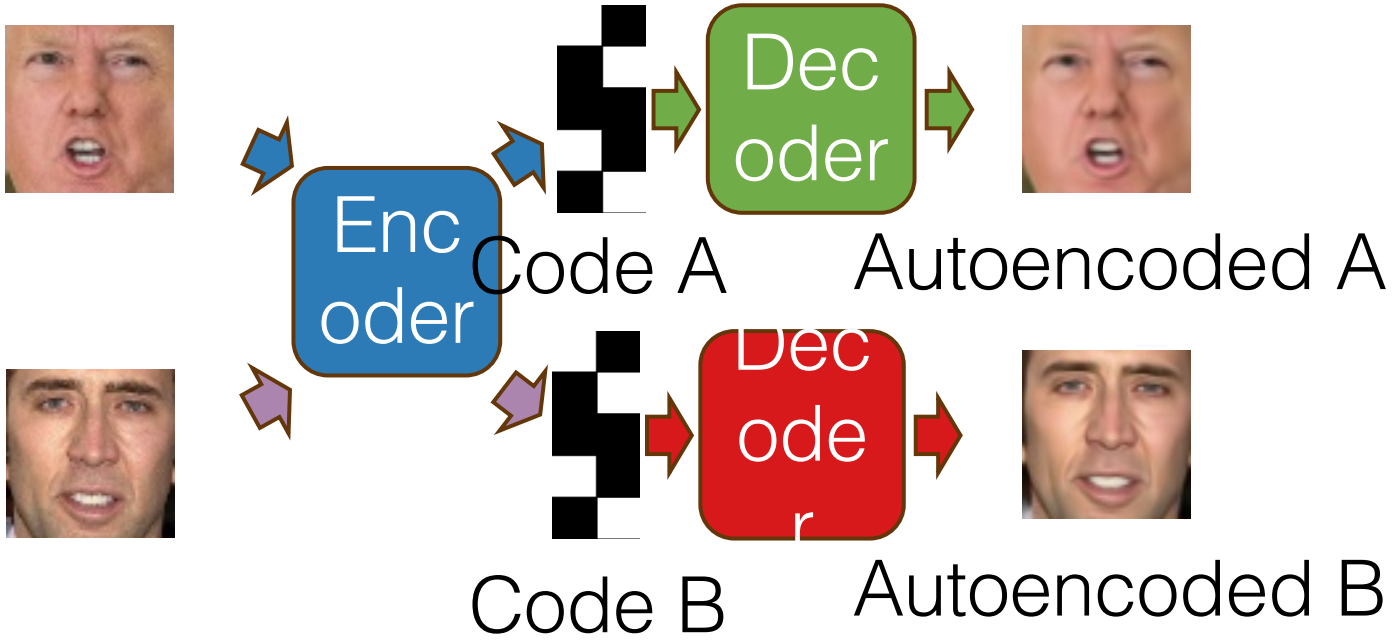


- Person B



Autoencoder

- Trick: Both use same Encoder during training
- Person A
- Person B

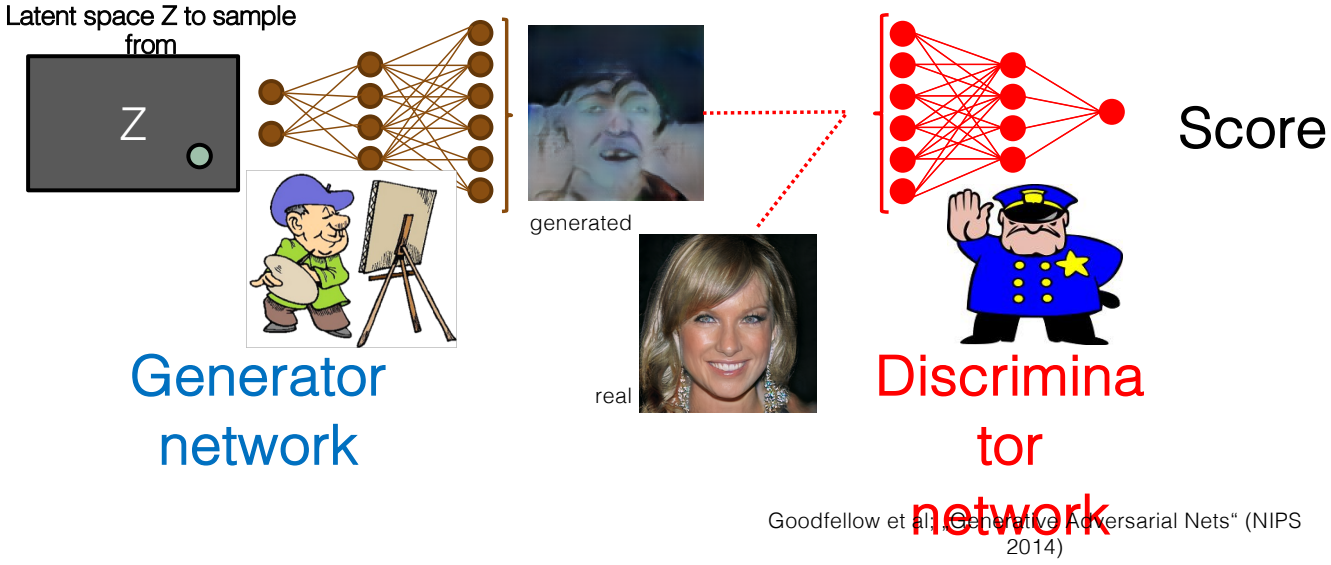


Deep fakes

- DeepTomCruise
- Viral on TikTok
- Discussions on SVT, SR, etc.

Så funkar det - del 2 – generera data

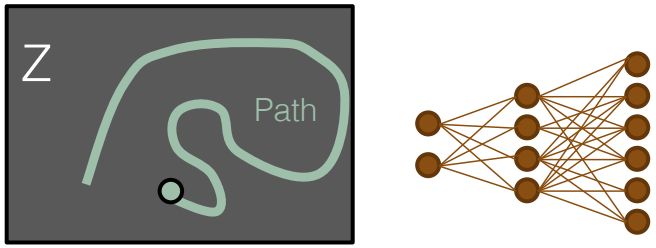
- Discriminator network - tries to distinguish generated from real data
- Generator network - tries to generate images that discriminator labels as real



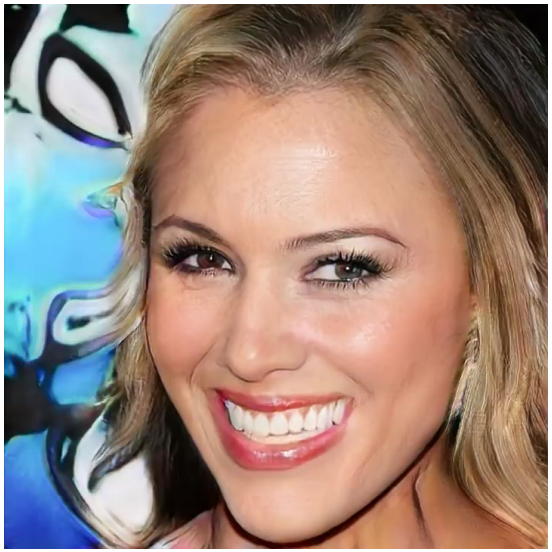
Goodfellow et al., "Generative Adversarial Nets" (NIPS 2014)

Så funkar det - del 2 – generera data

Path through latent space



Generator network



Karras et al; Progressive growing of GANs
https://www.youtube.com/watch?v=36lE9tV9vm0

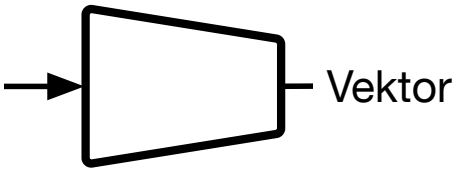
Använda AI för att generera data
Cycle-GAN

- Two sets of images (X and Y)
- Train
  - Converter X->Y(X)
  - Converter Y->X(Y)
  - Discriminator X vs X(Y)
  - Discriminator Y vs Y(X)
- Loss
  - X = X(Y(X))
  - Y = Y(X(Y))
  - Converter competes with discriminator

Zhu, J. Y., Park, T., Isola, P., & Efros, A. A. (2017). Unpaired image-to-image translation using cycle-consistent adversarial networks. *arXiv preprint arXiv:1703.10593*.

Dimensionality reduction

- Linear methods
- Autoencoders
- T-SNE
- UMAP



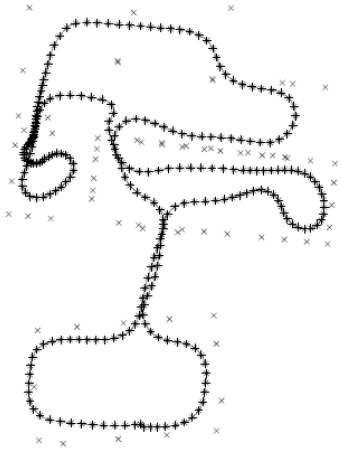
Visualizing our physical world

- Obtaining 3D models
- Analysis
- Visualizing 3D models
- Using models for localisation

Fridge content analysis 2002

Färnström, Johansson, Åström (2002). Computer Vision for determination of Fridge Contents

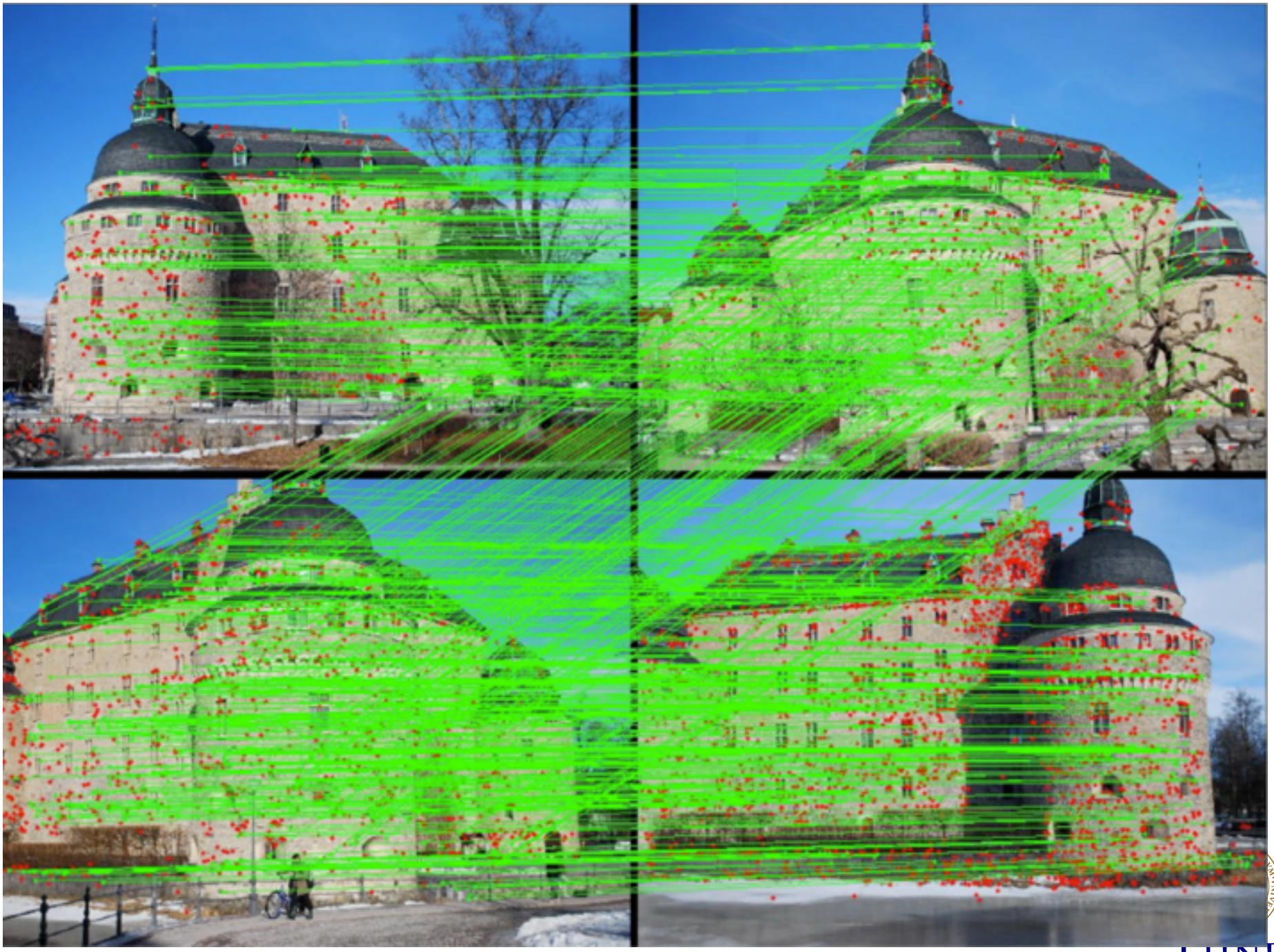
Autonomous systems – 1990
Dissemination - Danaher Motion



- Project 1990
- Masters thesis project 1991
- Real-time structure from motion.
- Minimal solvers
- Initial estimates
- Bundle adjustment
- Localization relative to map
- Loop closure
- Kiruna mine

Solutions and Ambiguities of the Structure and Motion Problem for 1D Retinal Vision
Åström, K. & Oskarsson, M. 2000 In : Journal of Mathematical Imaging and Vision. 12, 2, p. 121--135

Non-Sequential Structure from Motion Enqvist, Olof; Kahl, Fredrik; Olsson, Carl,
OMNIVIS, 2011.



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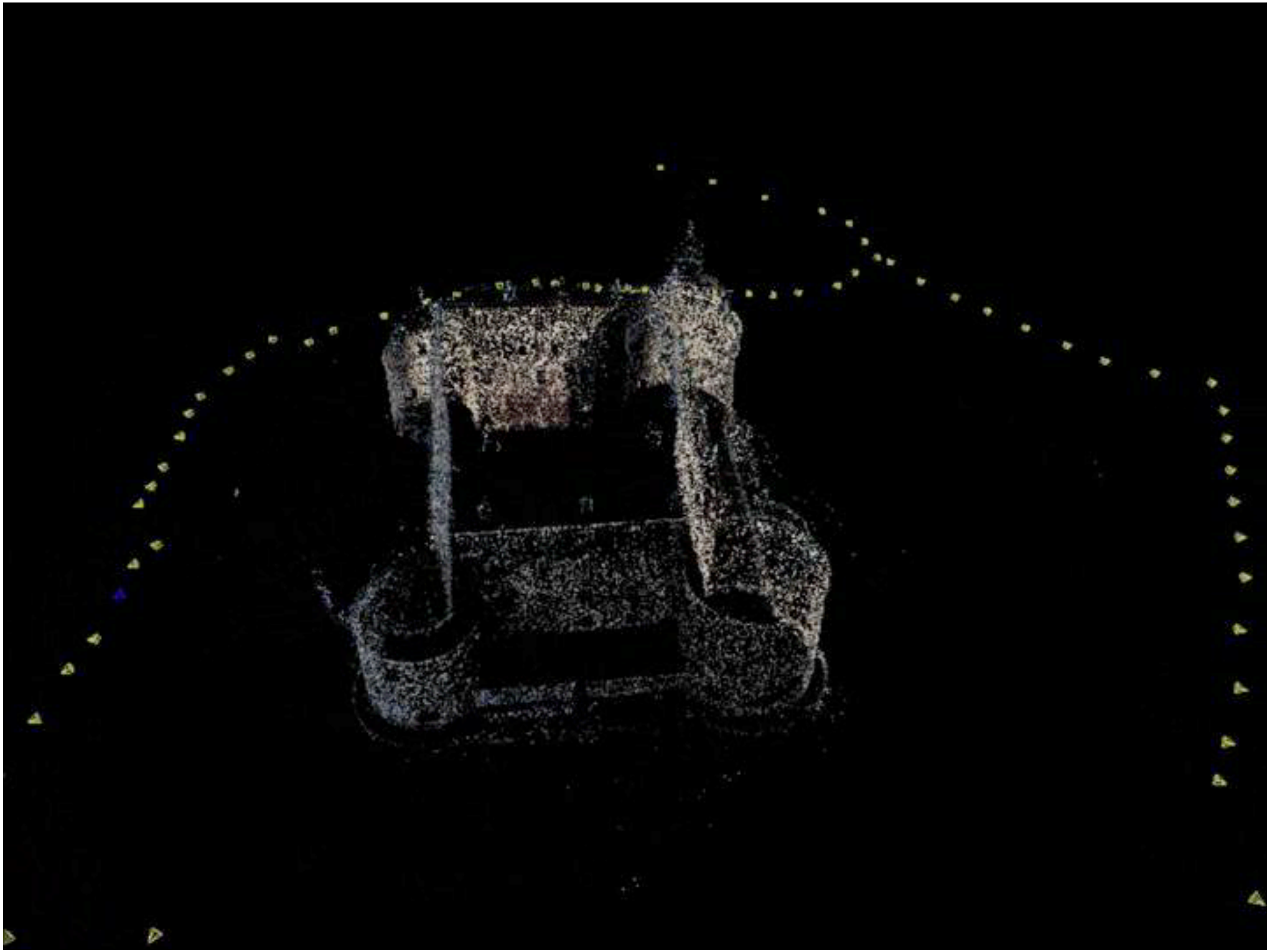

SAAB -> C3 Technologies -> Apple

Conjugate Gradient Bundle Adjustment
Byröd, M. & Åström, K. 2010 Computer Vision-Eccv 2010, Pt II. Springer, Vol. 6312, p. 114-127

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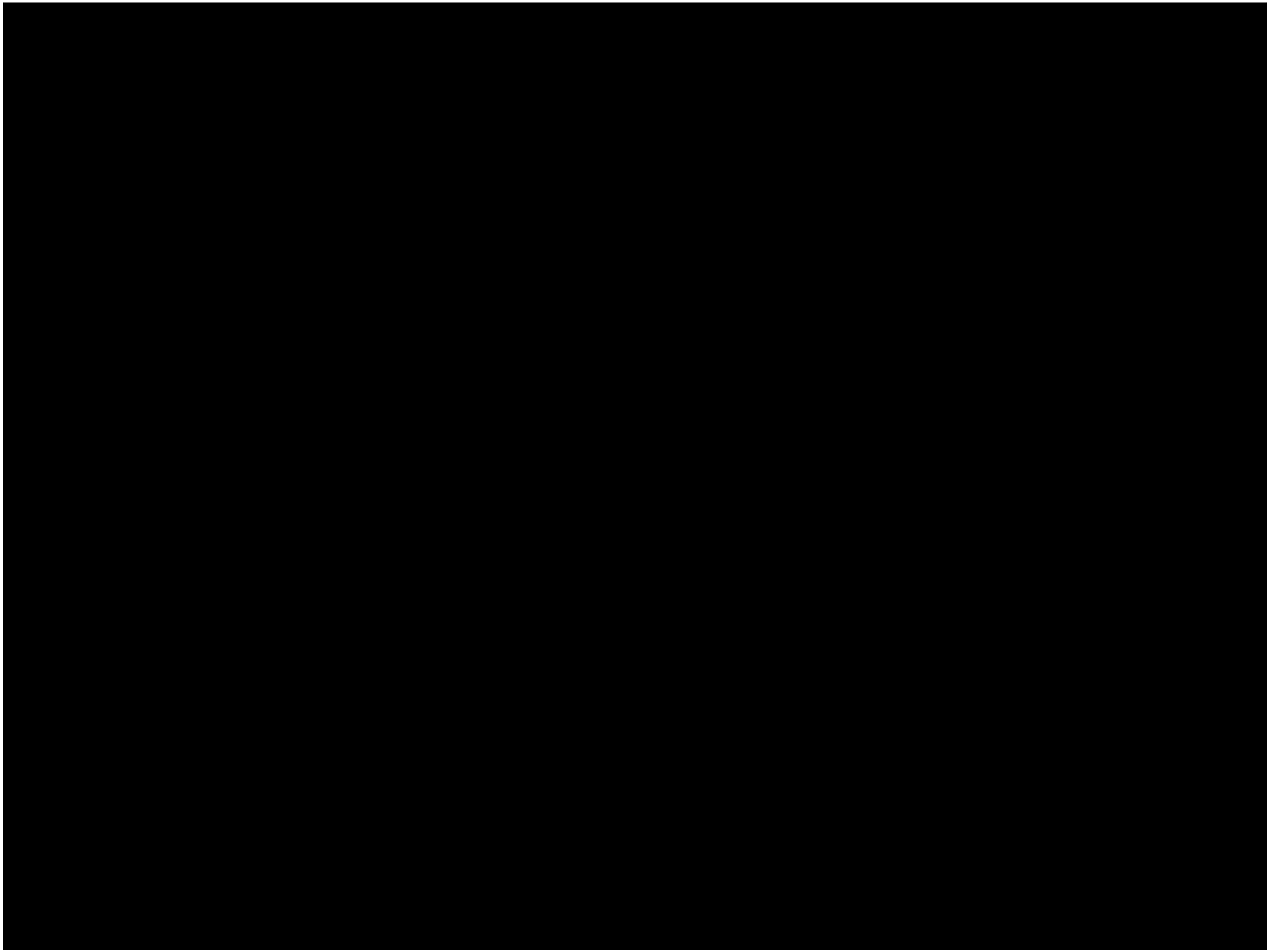
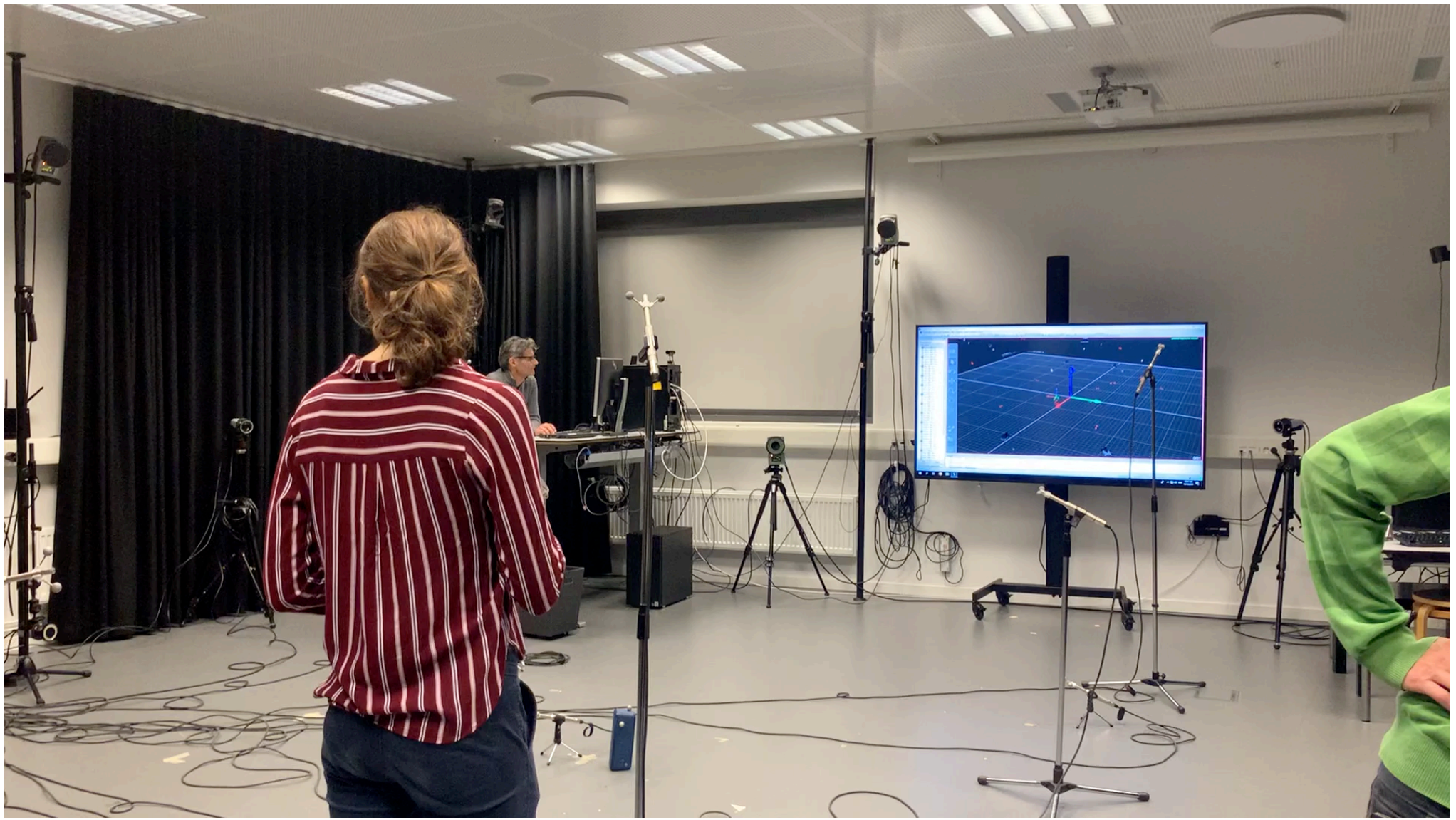
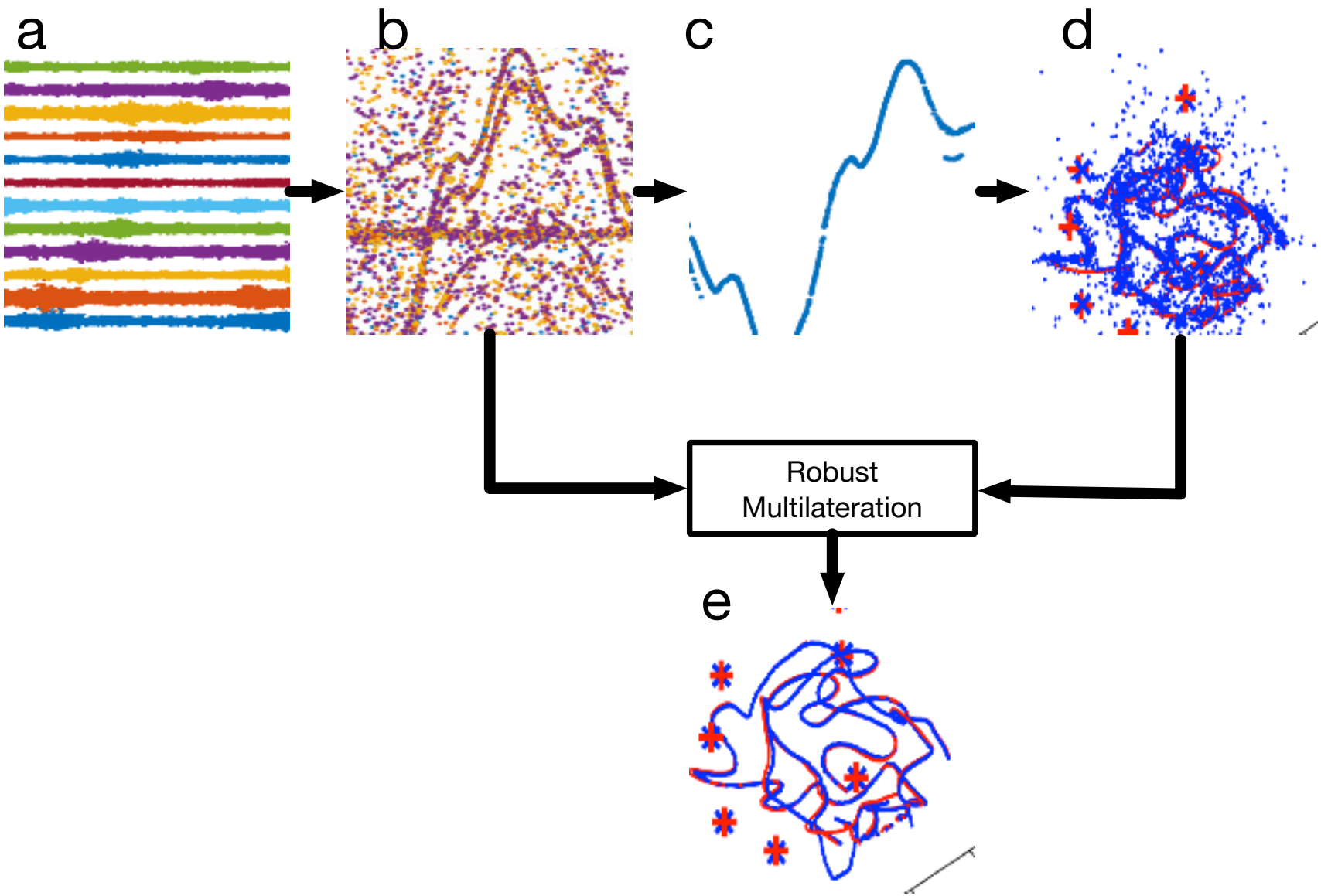
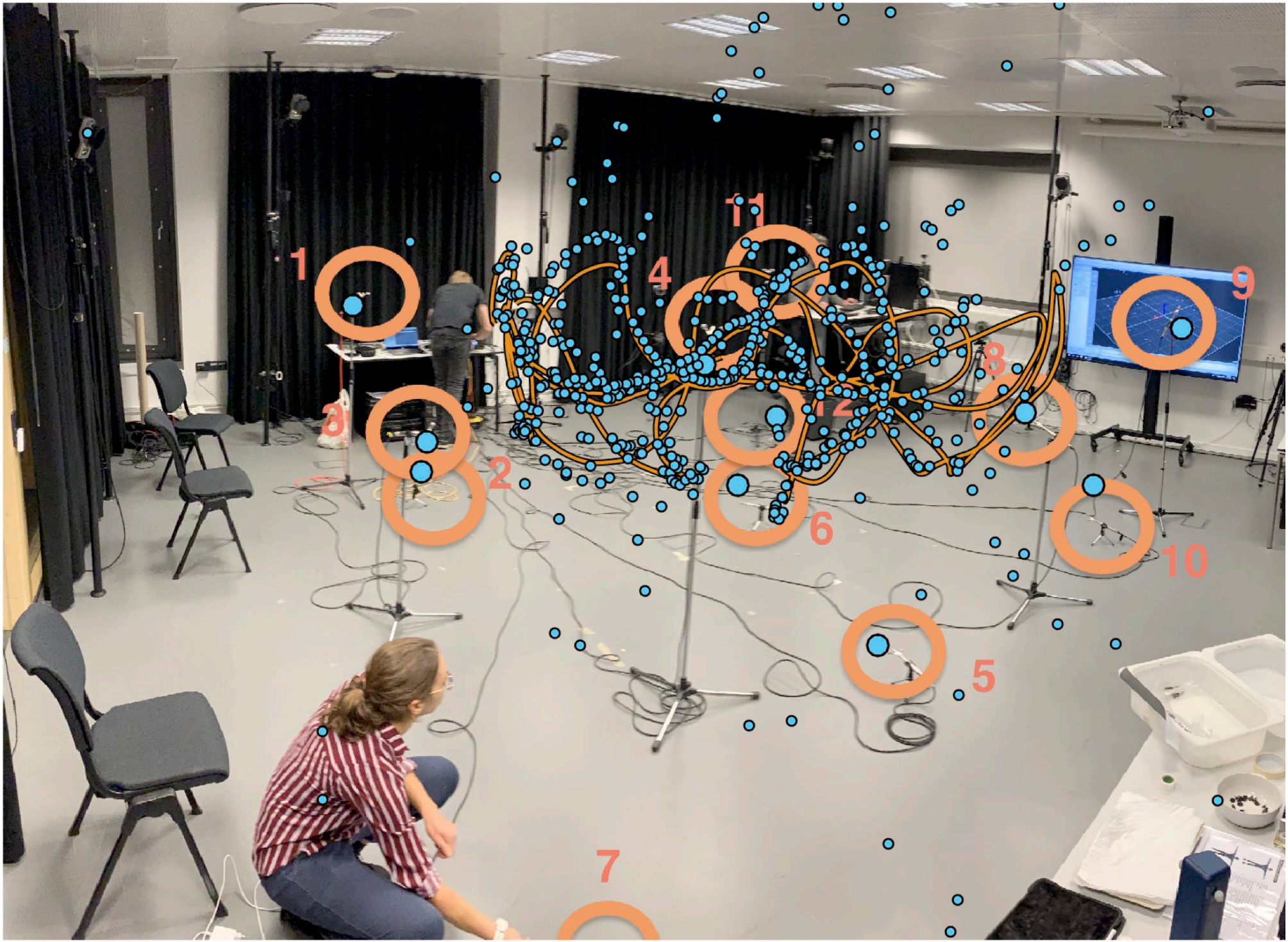


Structure from sound pipeline



Structure from sound pipeline

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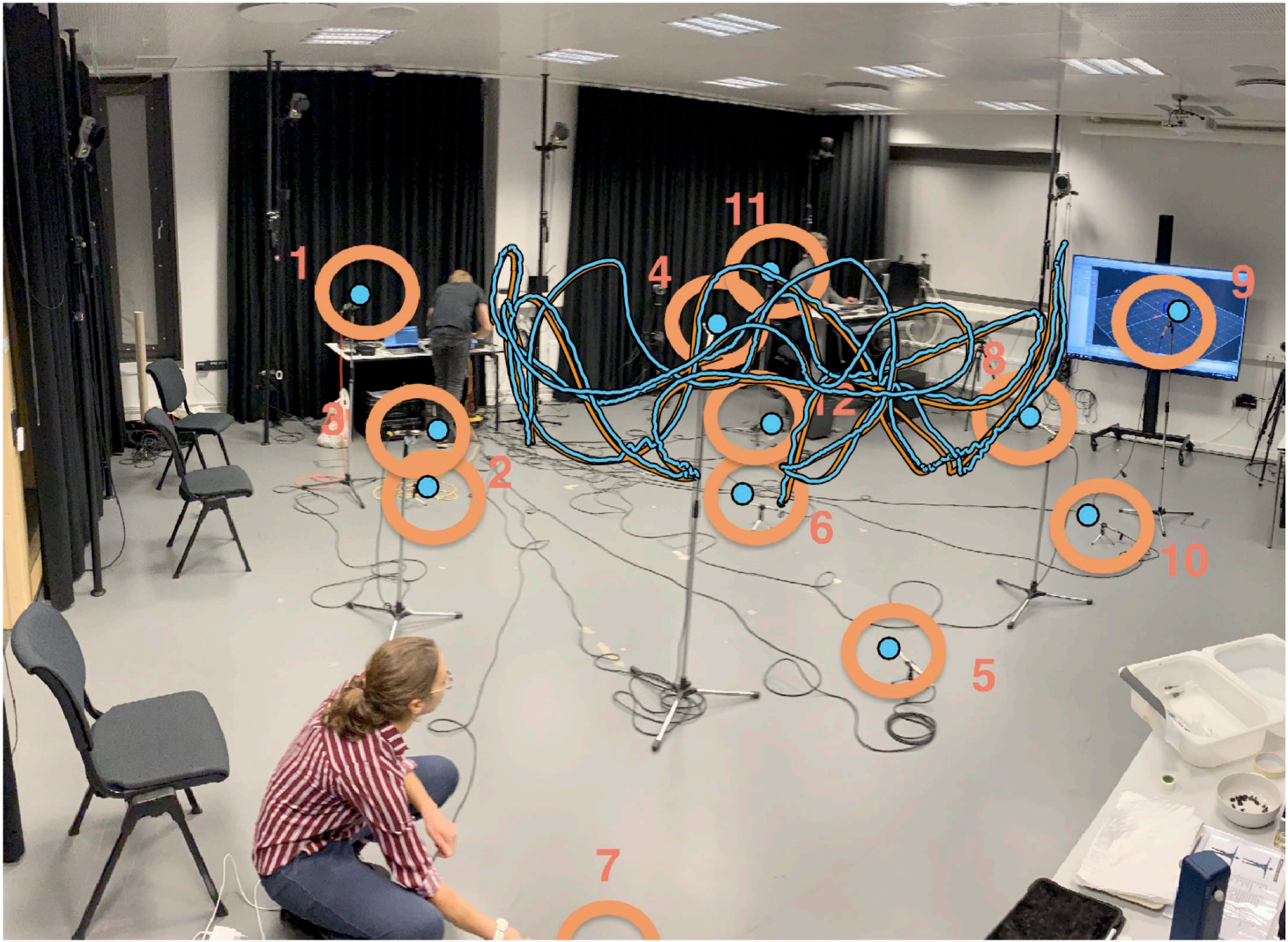
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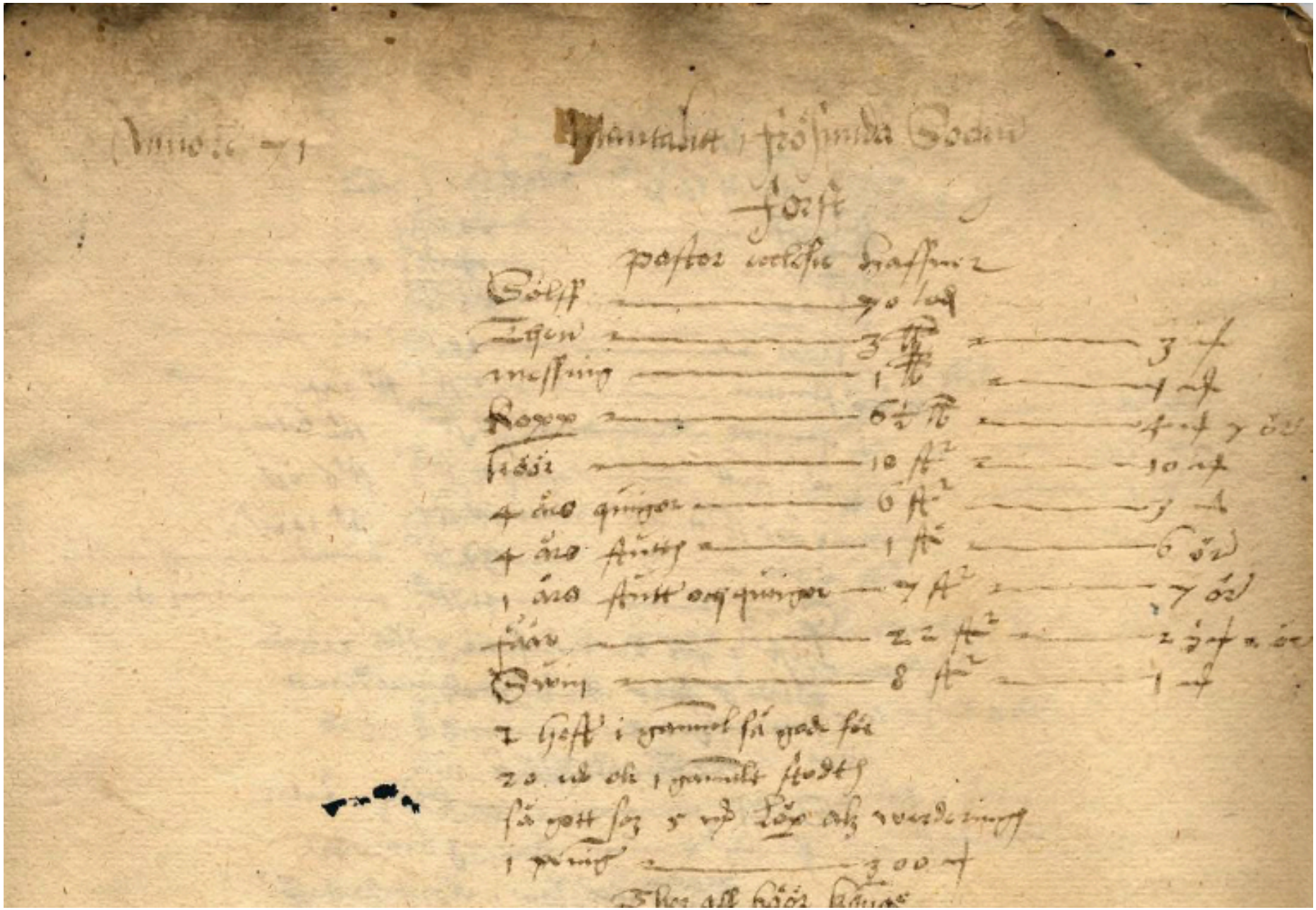
One more thing



Conclusions

- AI Lund
- Analysis and Visualization, Dimensionality reduction
  - PCA
  - Autencoder
  - T-SNE
  - UMAP
  - Method development
- Visualizing our physical world
  - Making maps from sensor data (image, video, radio, sound)
  - Visualizing the world
  - Positioning
- Älvsborgs lösen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