Classification and Reconstruction from Single Lines

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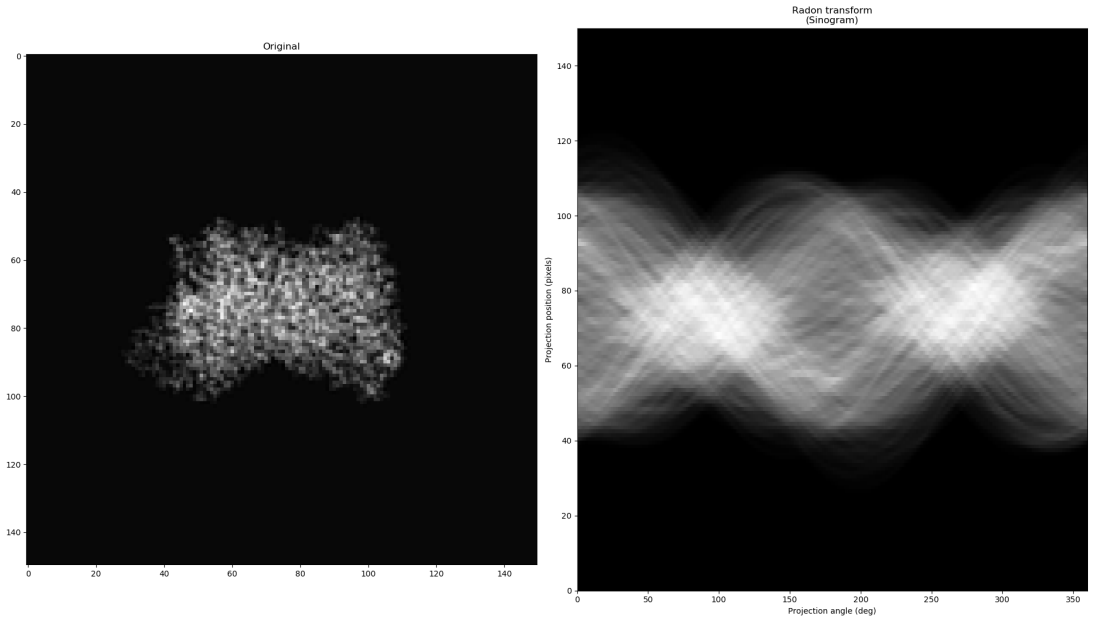

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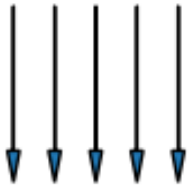

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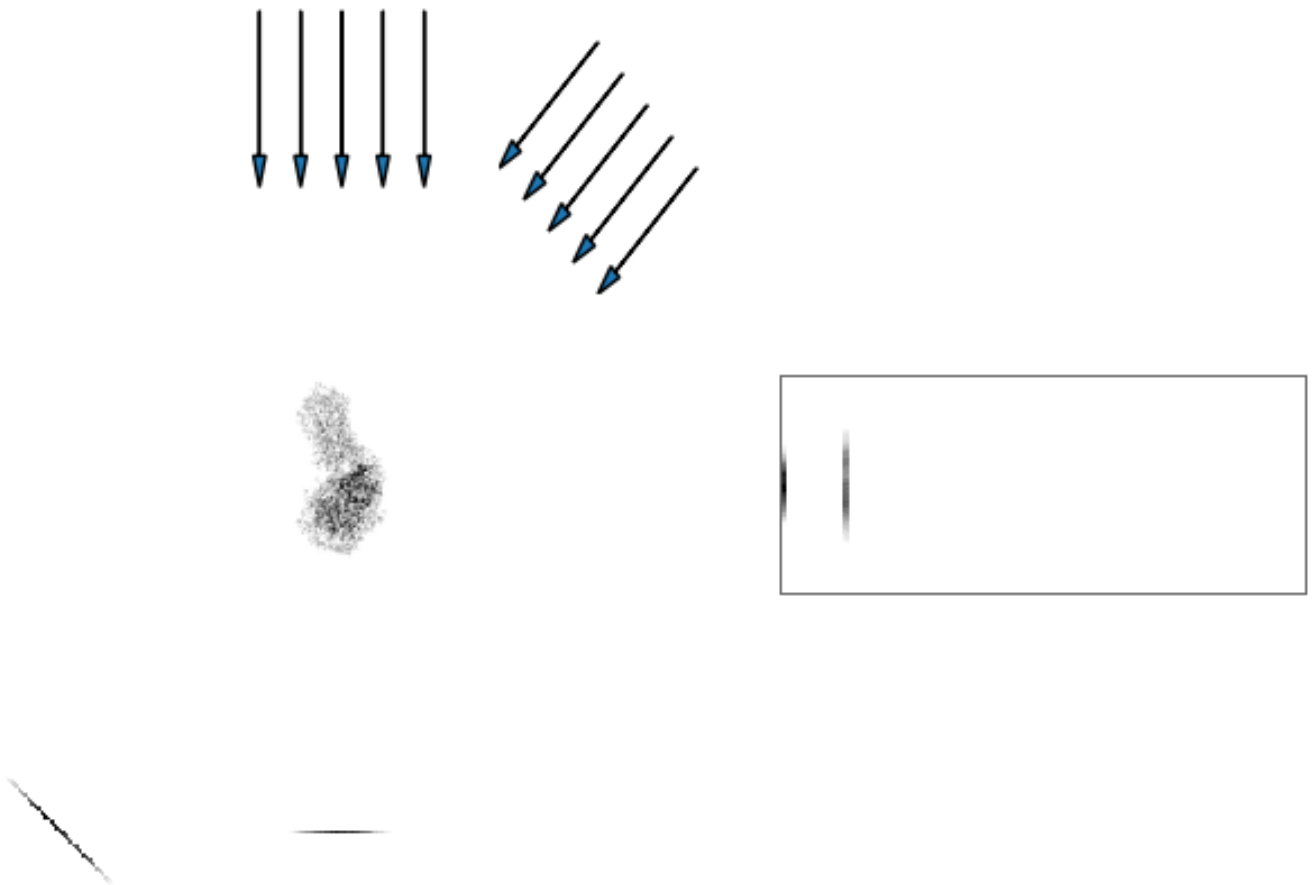

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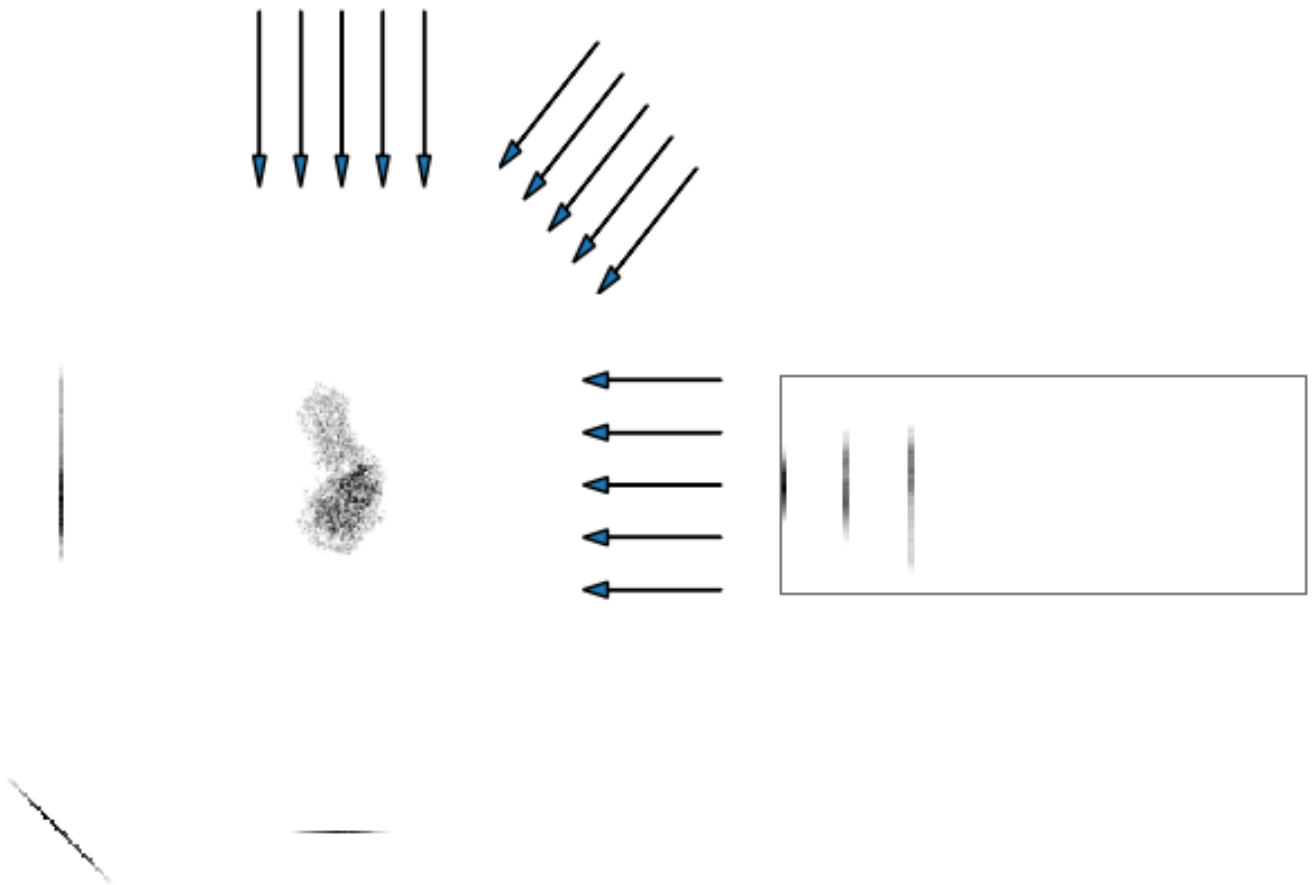

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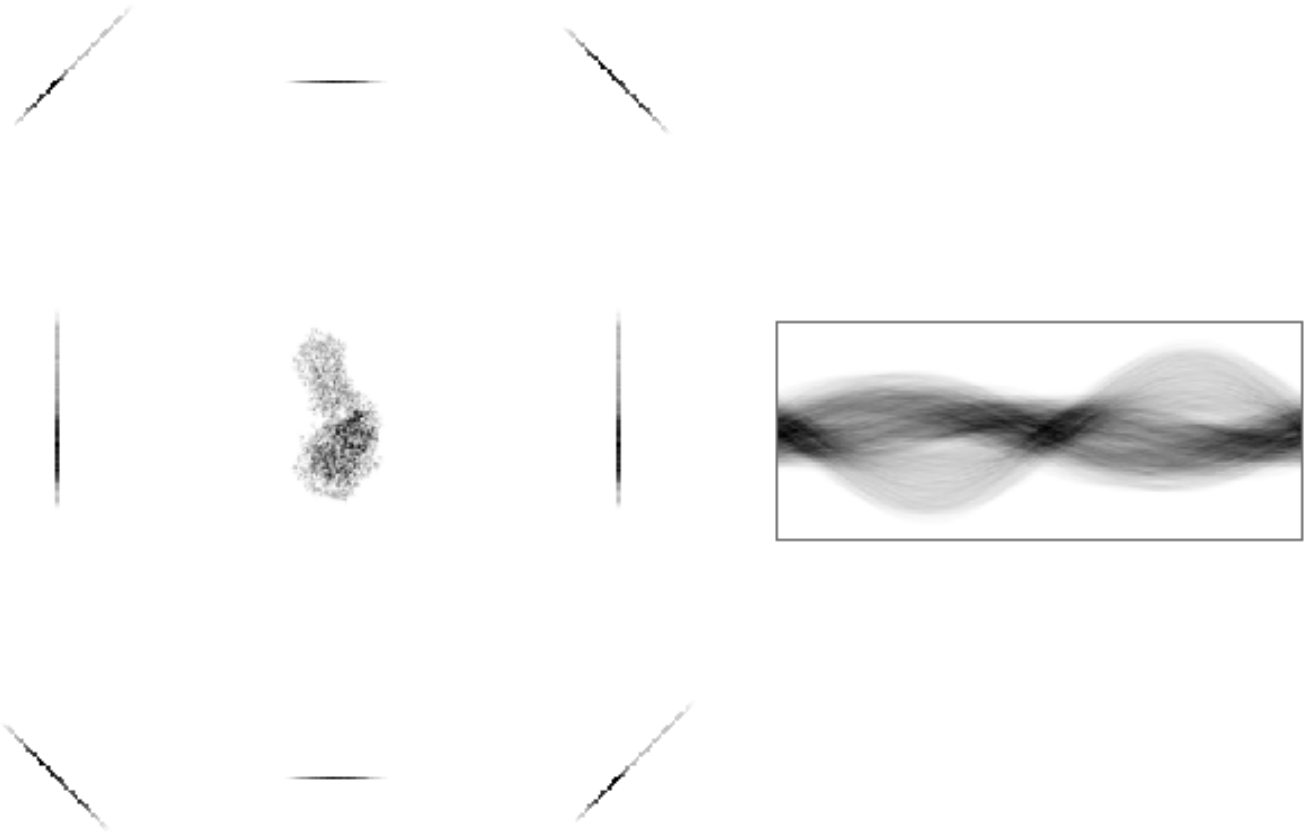


Common Lines

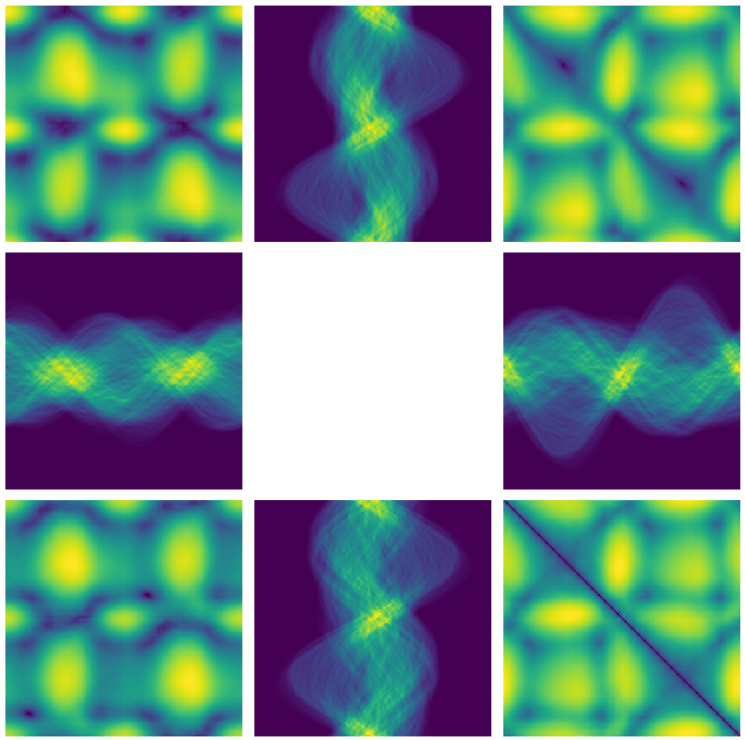
Explain why common lines between two 2D projections of the same 3D object will share a common line Show that sharing a common line gives tilt axis.

Two projections of the same 3D volume share at least one common line in the Radon transform

Detour! Angular recovery from 3 Common lines

Angular Reconstitution: A Posteriori Assignment of Projection Directions for 3d Reconstruction. Van Heel 1987

Show how to recover angles from 3 common lines. Maths! c.f will this work for more than 3? see slide X



Comparing single lines

Show different methods. Cross correlation, show single line as signal Problems! translation, noise, ctf...

Detour2! crYOLO

Particle picking improvements mean no longer have to rely on 2D classes to get sinograms from... Good centering, only particles being picked. Extensive use at eBIC will touch at the end...

Finding Common Lines

Raw single lines

Procedure for finding common lines. Get euclidian distances. Smallest is most similar

Dimensional Reduction

Dimensional reduction can be used to lower influence of noise and try to find common features of data. Manifold learning found to improve accuracy of common lines being chosen although more computationally expensive. Plot 2D pca of sinogram and non-linear Iso map or lle

Comparison between linear and non-linear dimensions

Graph of how lin vs non-lin change for different noise levels and different number of components

Bonus slide: NN architecture for comparing single lines

Could we use NN to find filters? Number of attempts but nothing stable as yet. Probably leave out as unsuccesful and long to explain - could do a passing mention

Reconstruction

Voting

Take all lines pairs under distance X This gives multiple possible axis between the same two projections. Weight these according to distance and number of times they appear. For each common line between two sinograms get more than 1 match so... vote which is best!

Over determined system

3 lines is all good for getting angular information back c.f. prev slide. any more than 3 and we can get contradicting equations - system is overdetermined. we have $N\hat{2}$ linear equations and only 6N variables (do proper maths) Machine learning 3! how to fit. Least squares optimization not good as we have large number of misidentified lines and nonconvex! we also need to get proper rotation matrices at the end. This constraint leads to collapse to trivial solution 000. Need other approach.

Eigenvector Relaxation

Explain in simple-ish terms Singer Shkolnisky method for finding Rotation matrices for each projection. Made in python! Using common lines in sinograms instead of in fourier. Maybe explain relationship between two. Show their results of how no. of correct common lines affect final result.

Models!

Lots of models!

Computational efficiency

only calculating 95% of correct lines make others random. 6x speed increase. Parrallelisation needed! Show that adding random lines does not affect recon too much..

Priming matrix with tilt data! - Not done yet

With tilt data we know the tilt axis (and angle but this is not important) Can calculate what common single line would be for this data would be. can input straight into matrix

Clustering - Not done yet

Can heterogenaity be sorted by looking at common lines?

A

- Lorem Ipsum
- Dolor est
- Example incoming
- Example arrived

B

- Sometimes its hard to make up random content
- Othertimes not
- Filler words
- And filler phrases that are ever so slightly longer

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