HELMHOLTZ IMAGING PLATFORM

Deep Learning for Helmholtz Imaging at DESY IT

Philipp Heuser

David Schwarz, Franz Rhee, Ivo Baltruschat, Sahar Kakavand

UniSeF

Universial Segmentation Framework

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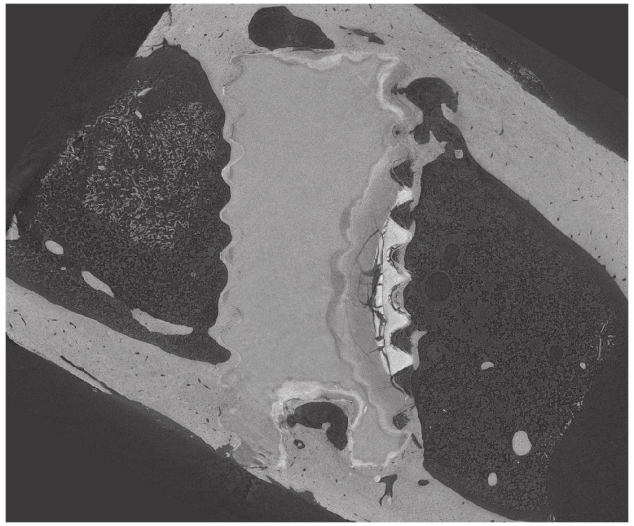
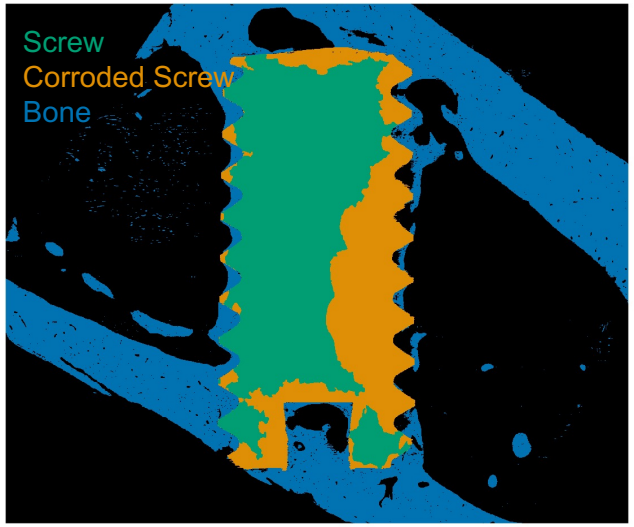
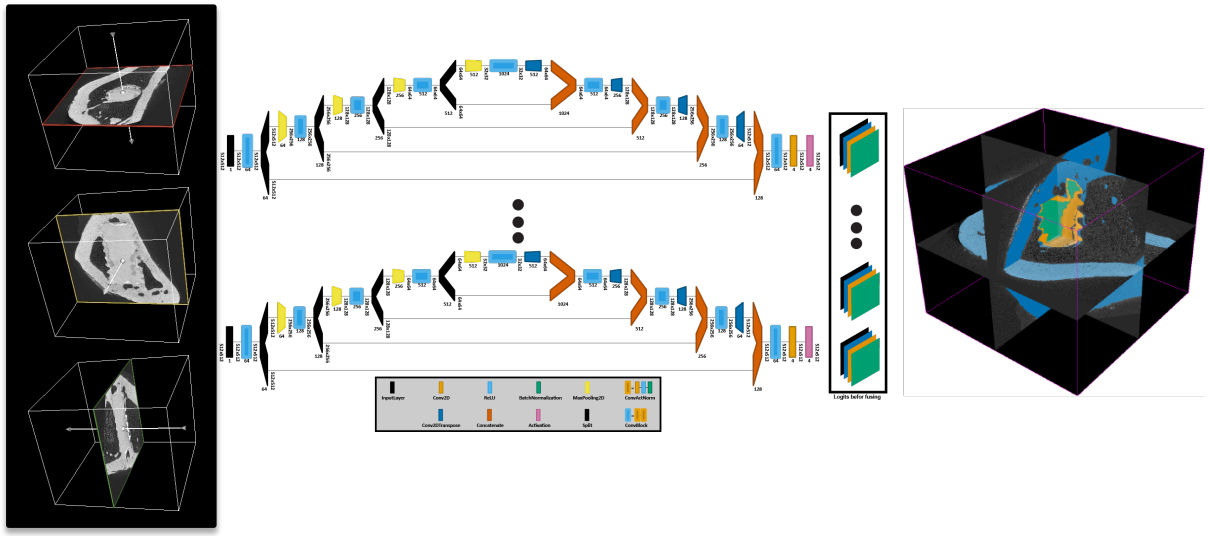
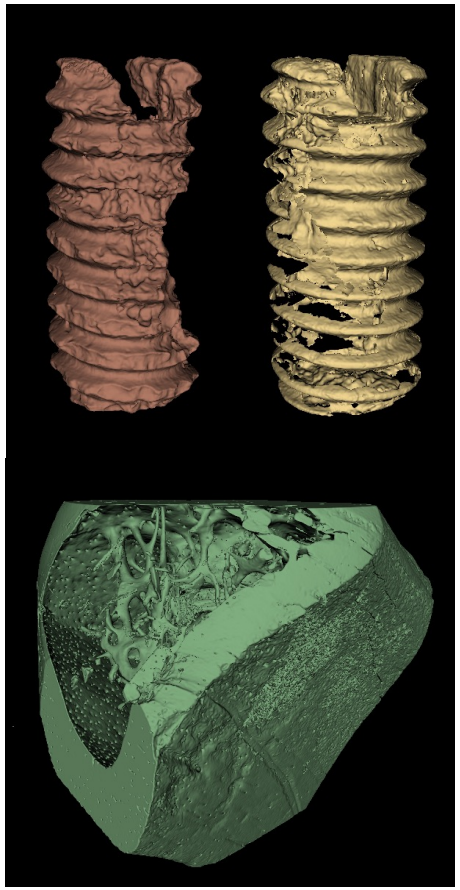
Semantic Segmentation

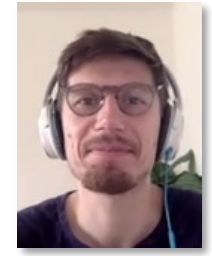






Optimised and scaled U-Net for the semantic segmentation of SRμCT data





Scaling the U-net: Segmentation of biodegradable bone implants in high resolution synchrotron microtomograms
IM Baltruschat, H Slominska, D Krüger, B Zeller-Plumhoff, R Willumeit-Römer, J Moosmann, P Heuser, **Scientific Reports 2021 accepted**

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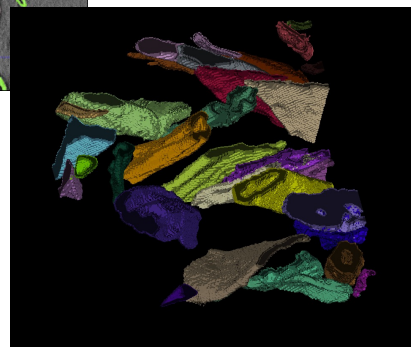
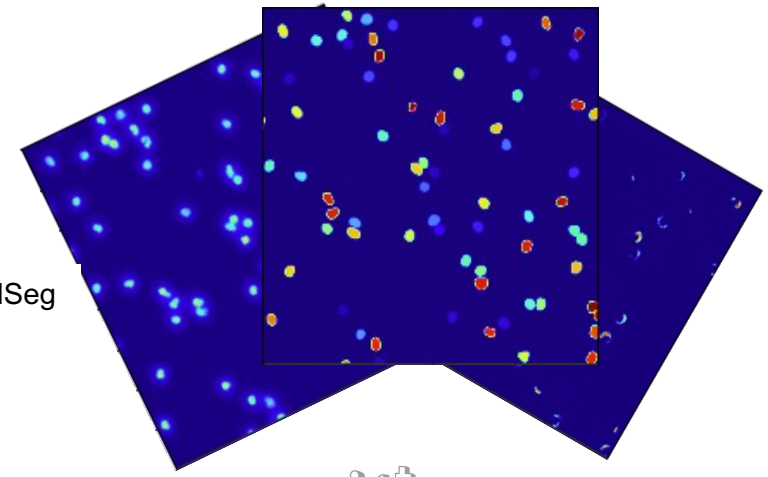
Segmentation



Instance segmentation of paper fibres in 3D **SRµCT tomograms**

EMBEDSEG

https://github.com/juglab/EmbedSeg
Lalit et al. 2021

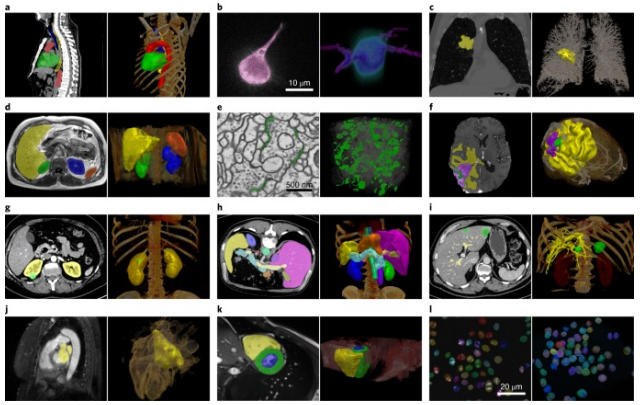


StarDist

https://github.com/stardist/stardist
Weigert et al. 2020

nnUnet

Isensee, F., Jaeger, P. F., Kohl, S. A., Petersen, J., & Maier-Hein, K. H. (2020). nnU-Net: a self-configuring method for deep learning-based biomedical image segmentation. Nature Methods, 1-9.



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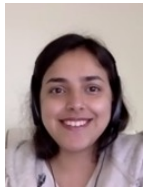
Universial Segmentation Framework



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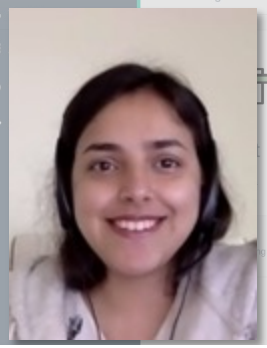
Active Learning

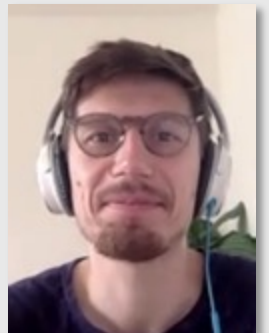
Segmentation ✓

Confidence/Uncertainty



Sahar Kakavand

Bashir Kazimi

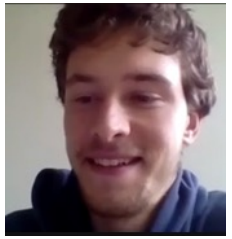


Ivo Baltruschat

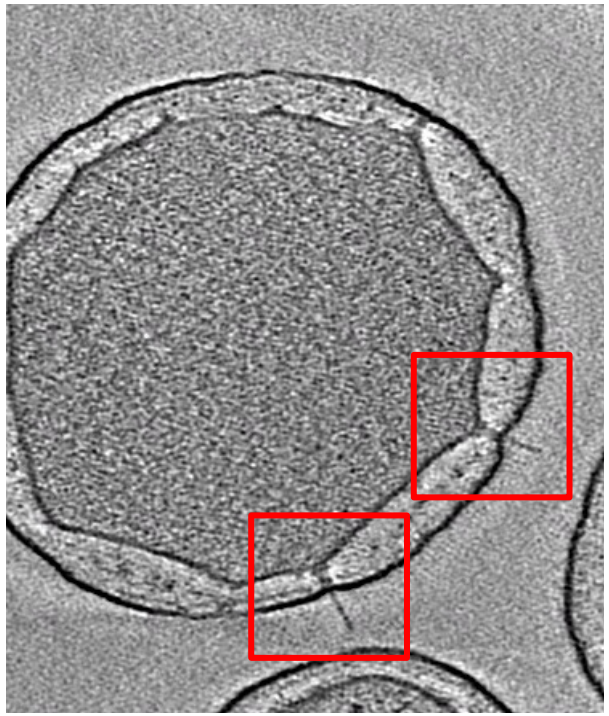
Erik Genthe, Sean Miletic, Tom Marlovits, Philipp Heuser

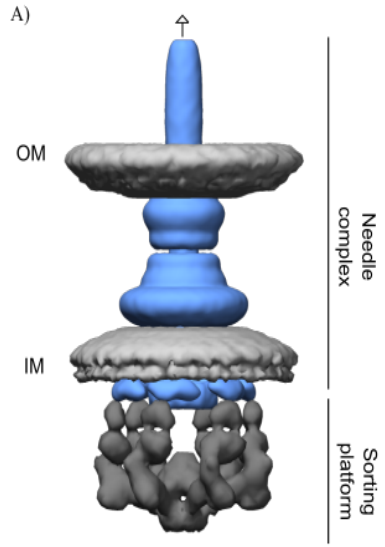
PickYOLO

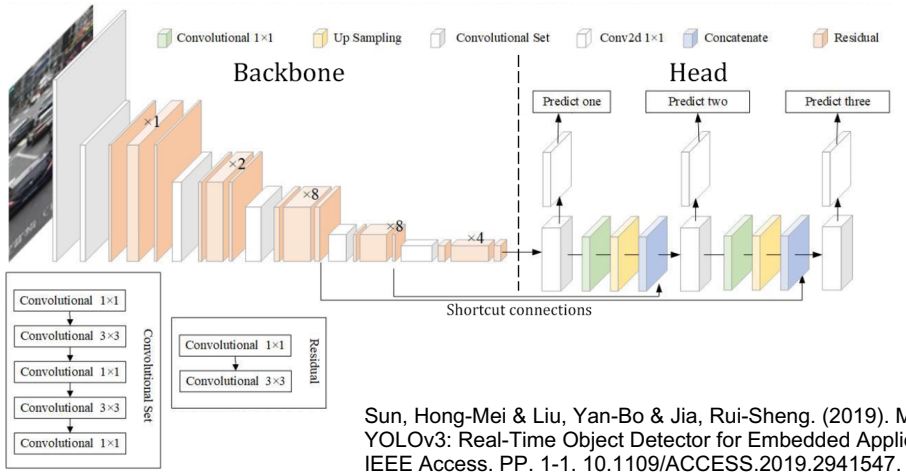
A deeplearning detector for particle picking in CryoET



Erik Genthe







Sun, Hong-Mei & Liu, Yan-Bo & Jia, Rui-Sheng. (2019). Mini-YOLOv3: Real-Time Object Detector for Embedded Applications. IEEE Access. PP. 1-1. 10.1109/ACCESS.2019.2941547.

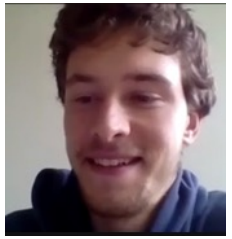
Paramter	Wert	Hinweis
Backbone	Darknet21	
Optimizer	SGD + Mom.	
Learningrate	0.00026	
Momentum	0.9	
Weight Decay	0.0006	
Batchsize	16	
Faktor für FN	4.0	
Epochen	60	
Höhe & Breite der Boxen	32 px	
Tiefe der Boxen	11 px	
min predictions (Clustering)	23	Dynamisch Optimiert
eps (Clustering)	7.0	Dynamisch Optimiert
Tiefe der Don't Care Zonen	16 px	Automatisch gesetzt

DESY.
CSSB Centre for Structural Systems Biology
HIP

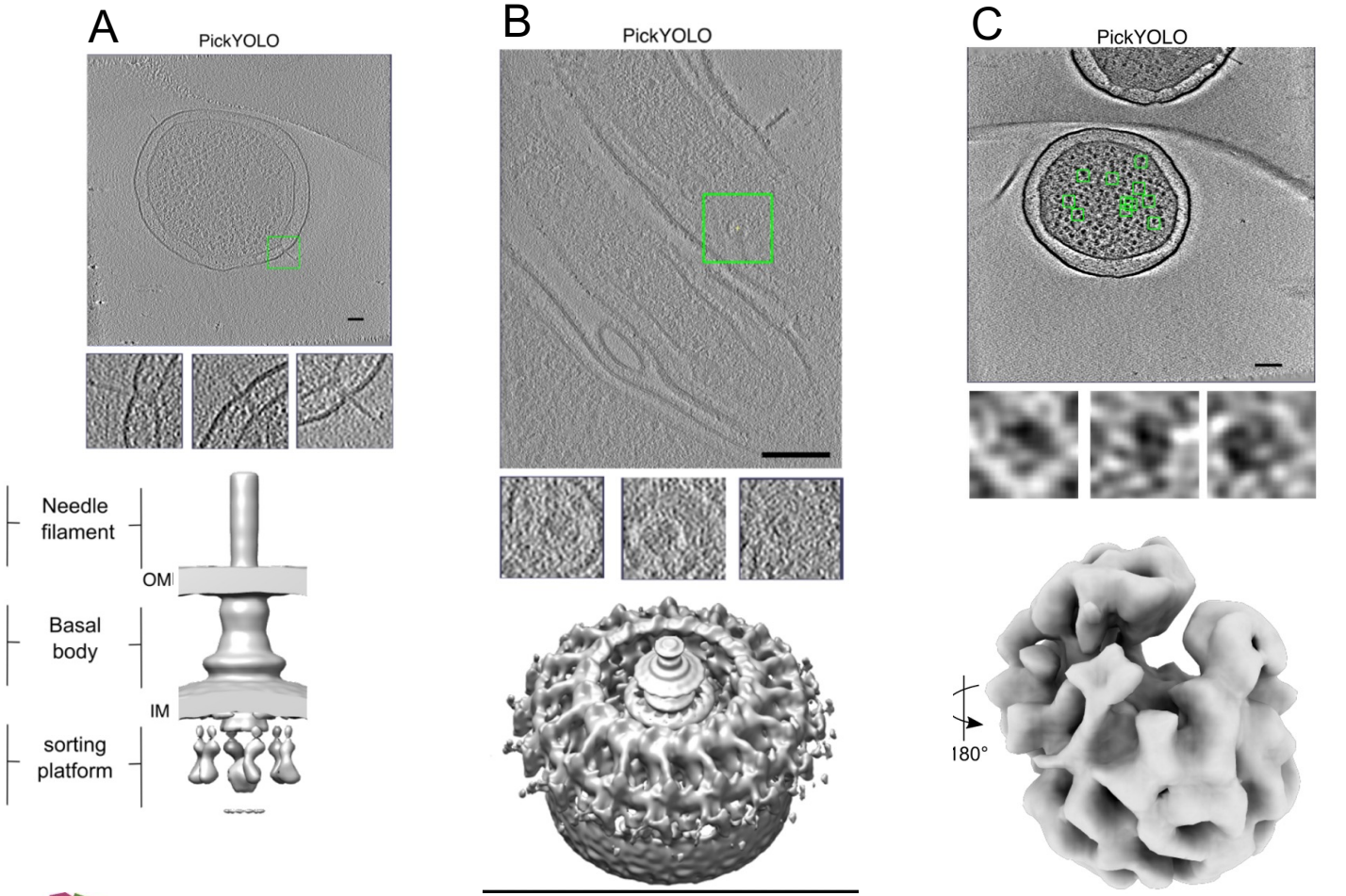
Erik Genthe, Sean Miletic, Tom Marlovits, Philipp Heuser

PickYOLO

A deeplearning detector for particle picking in CryoET



Erik Genthe



A) **T3SS membrane complexes** in *Salmonella* minicells
B) **flagellar membrane** complexes in *Borrelia burgdorferi*
C) **cytoplasmic ribosome complexes** in *Salmonella* minicells

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PickYOLO: Deep learning particle detector for annotation of cryo electron tomograms; almost done

CSSB Centre for Structural Systems Biology

HIP

UniSeF / PickYolo / AI

as a service?

- How can DL be made available/usable to the non-expert?
- AI in the cloud
- Can we do this using DESY infrastructure?
    - maxwell
    - open stack / kubernetes

Ivo Baltruschat
Semantic Segmentation
Uncertainity in ML
MDLMA

Franz Rhee
HIP

Sahar Kakavand
UniSef
Instance Segmentation

"Research and Innovation in Scientific Computing"
RIC Group / DESY IT

Erik Genthe
PickYolo

David Schwartz
HIP

Thanks

Hereon:
Julian Moosmann
Berrit Zeller-Plumhoff
Hanna Malgorzata
Bashir Kazimi
Christian Lucas

CSSB:
Tom Marlovits
Sean Miletic

DESY:
Patrick Fuhrmann
Frank Schlünzen
Tim Wetzel
Michael Schuh
Johannes Replin

Funding:

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HELMHOLTZ AI | ARTIFICIAL INTELLIGENCE COOPERATION UNIT

Bundesministerium für Bildung und Forschung