X-ray computed tomography-based modelling for feature-dependent and independent meshing of heterogeneous material

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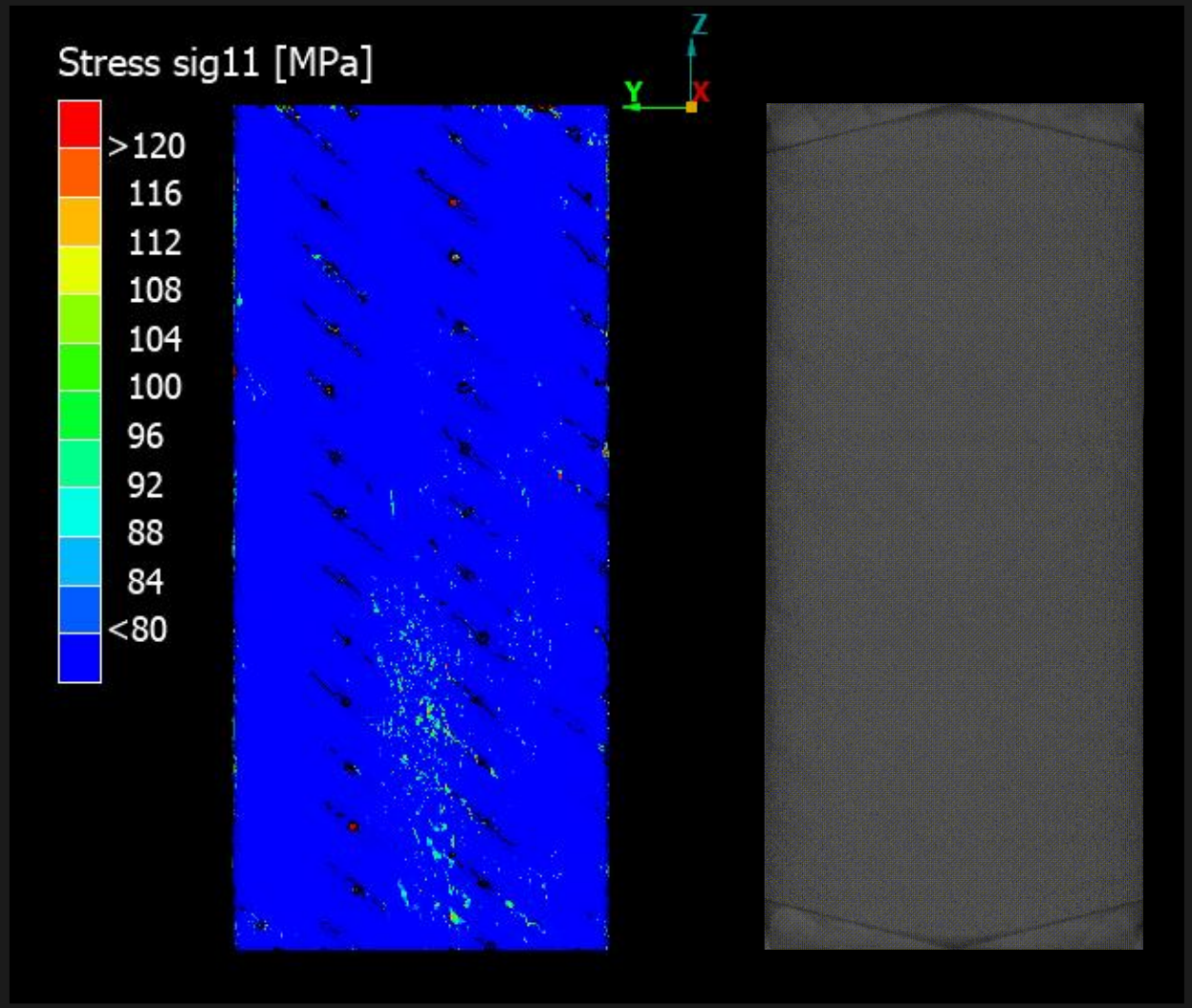
Imaged-based modelling



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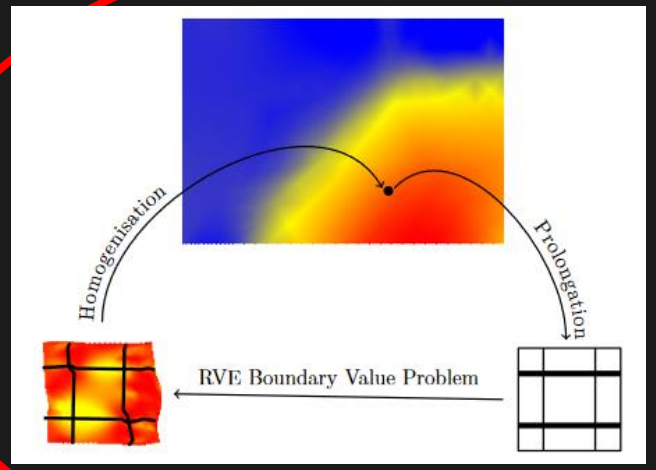
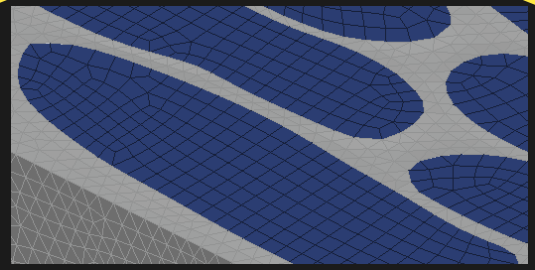
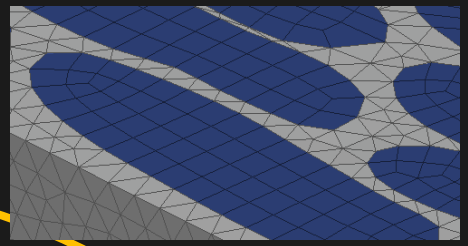


Accurate modelling

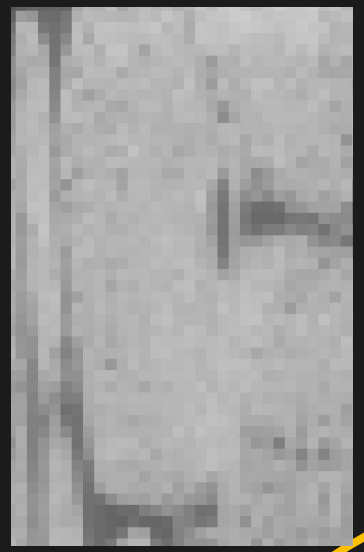




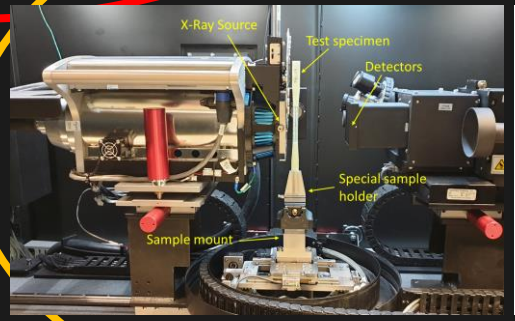
A. Sciegaj, Multiscale modelling of reinforced concrete structures, PhD Thesis (2020)

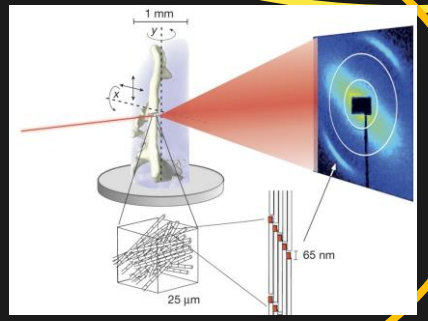
D. Wilhelmsson, Compressive failure of unidirectional NCF composites, PhD Thesis (2019)

Imaged-based modelling



Accurate imaging

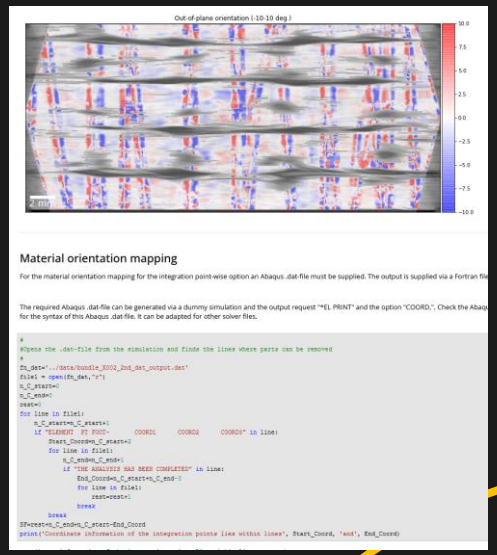




R. M. Auenhammer et al., Automated x-ray computer tomography segmentation method for finite element analysis of non-crimp fabric reinforced composites, *Composite Structures*, **256**, 113136 (2021)

M. Liebi et al., Nanostructure surveys of macroscopic specimens by small-angle scattering tensor tomography, Nature **527**, 349-352 (2015)

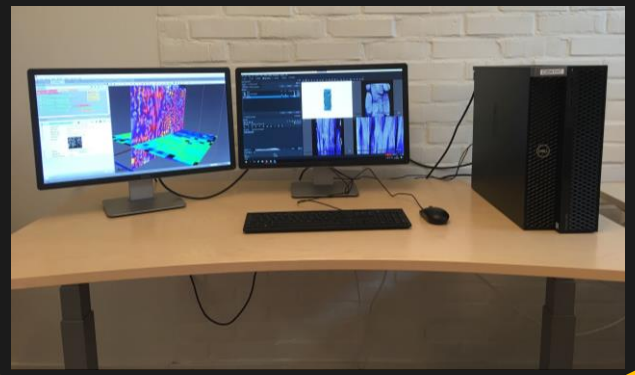
Imaged-based modelling



Accurate
image analysis

RETOMO
PIXEL TO OBJECT

Avizo®



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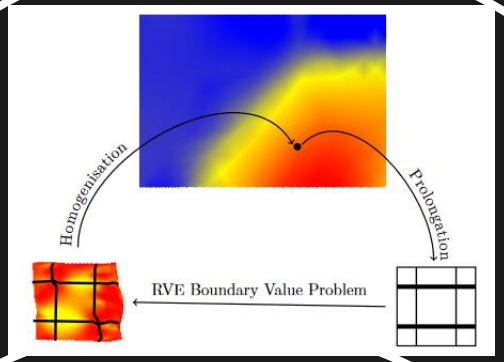

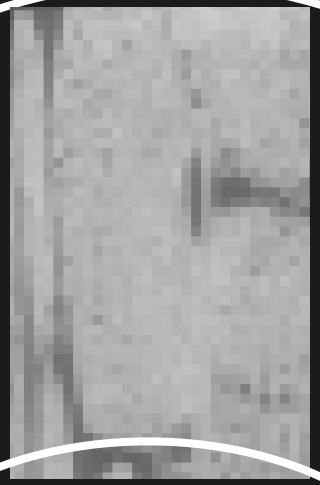

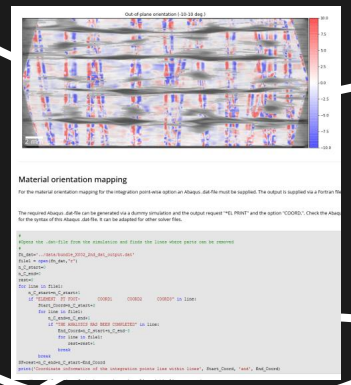

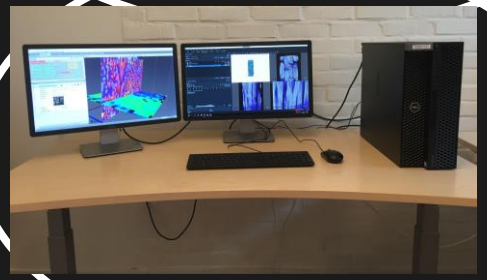

RETOMO
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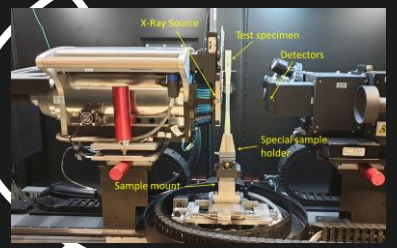
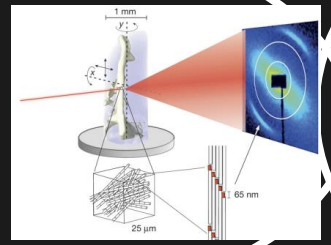
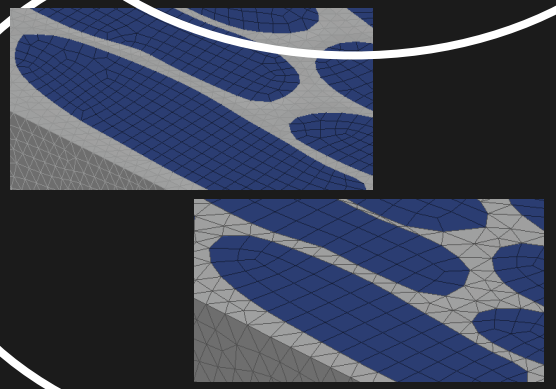






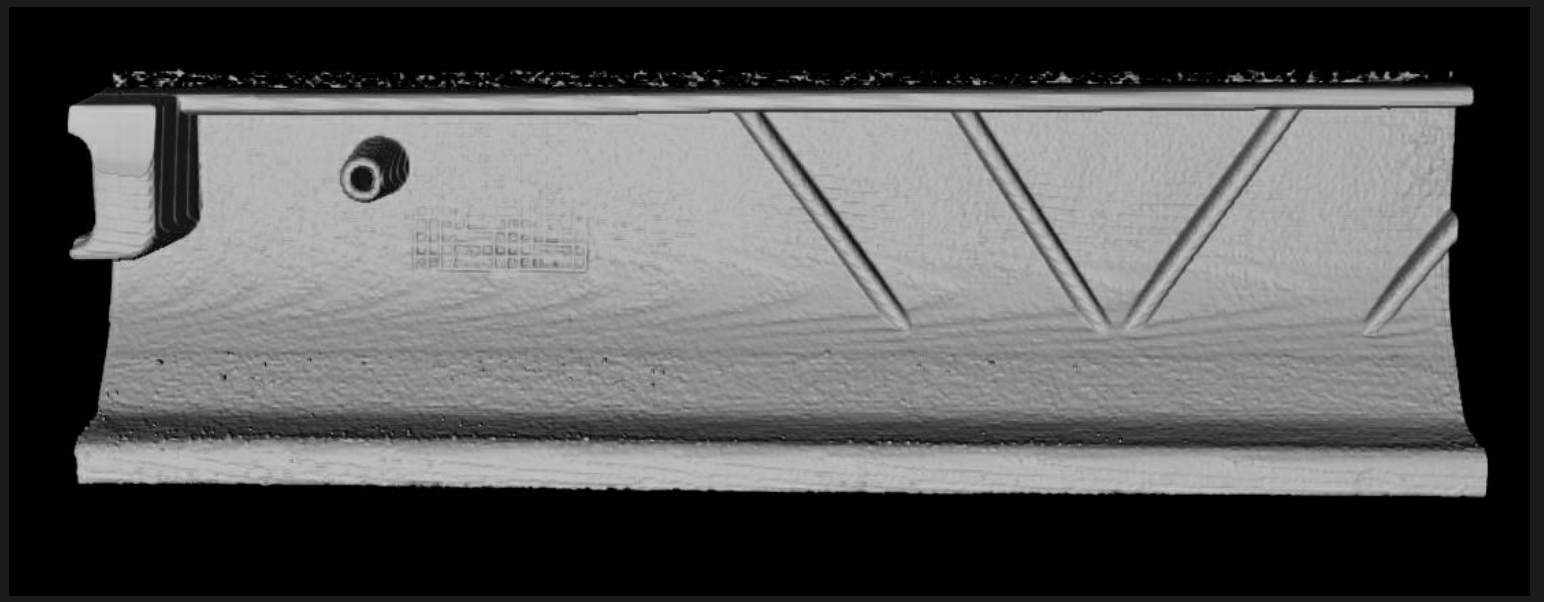
Imaged-based modelling

Accurate material
behaviour prediction

X-ray computed tomography aided engineering (XAE) Process

X-ray computed tomography aided engineering (XAE) Process

Image acquisition →



X-ray computed tomography aided engineering (XAE) Process

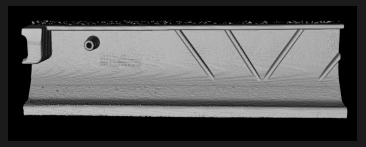
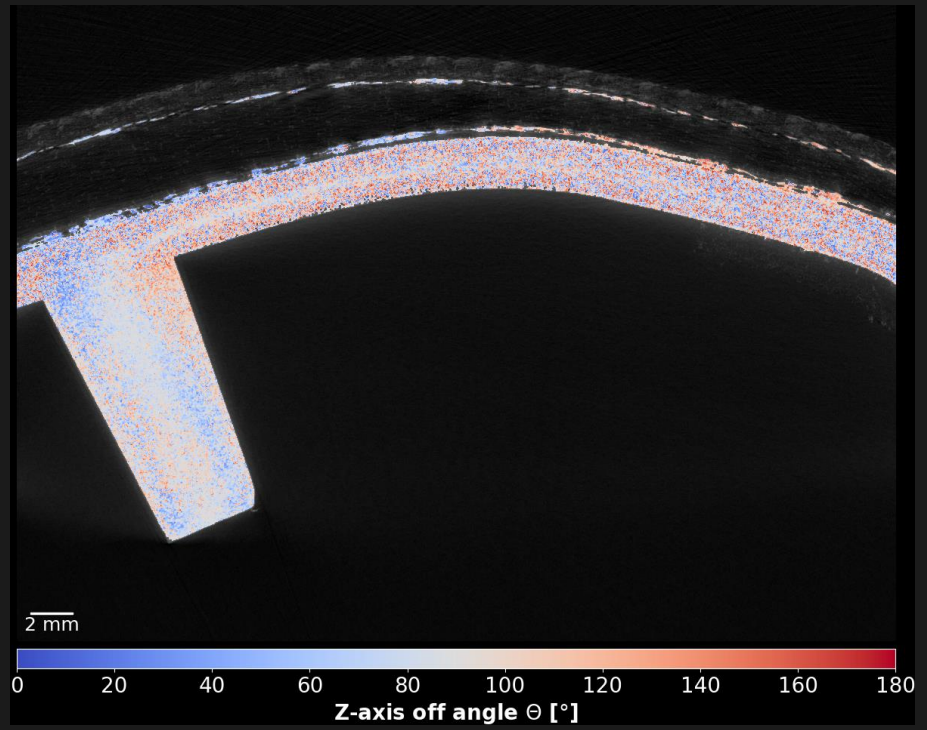


Image acquisition → Segmentation



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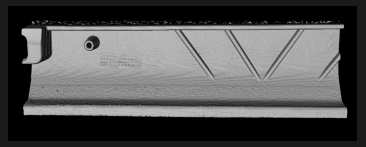


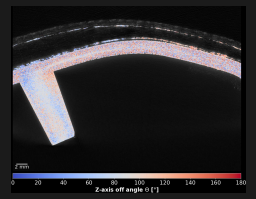
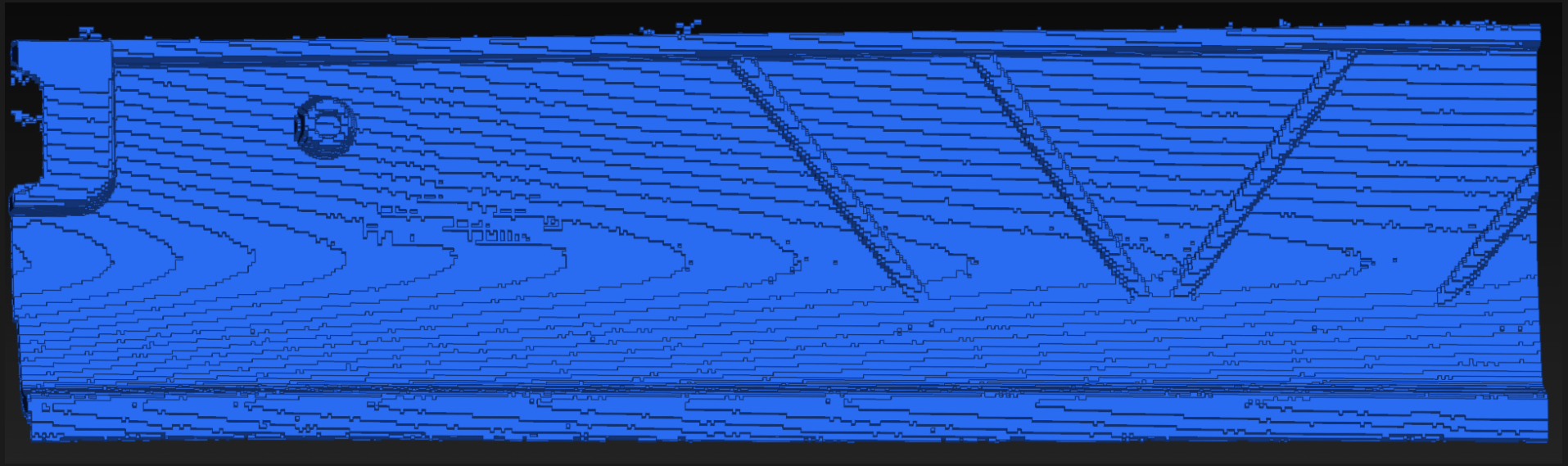
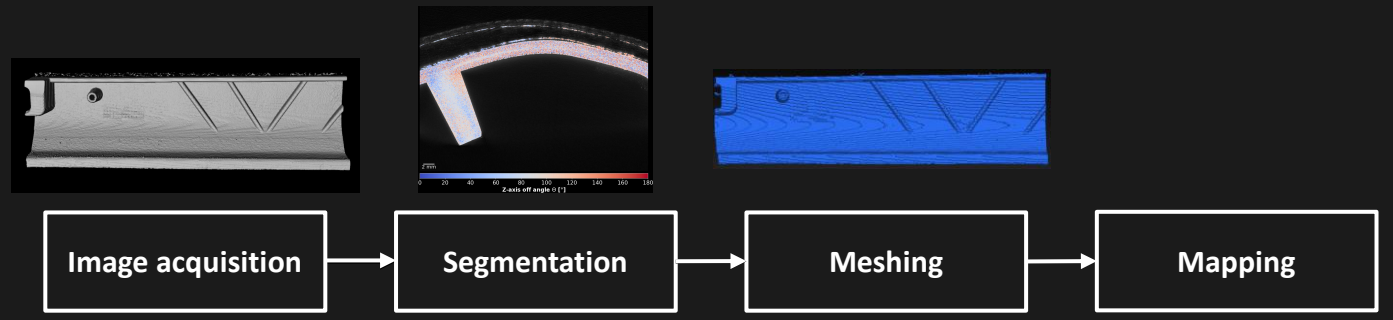
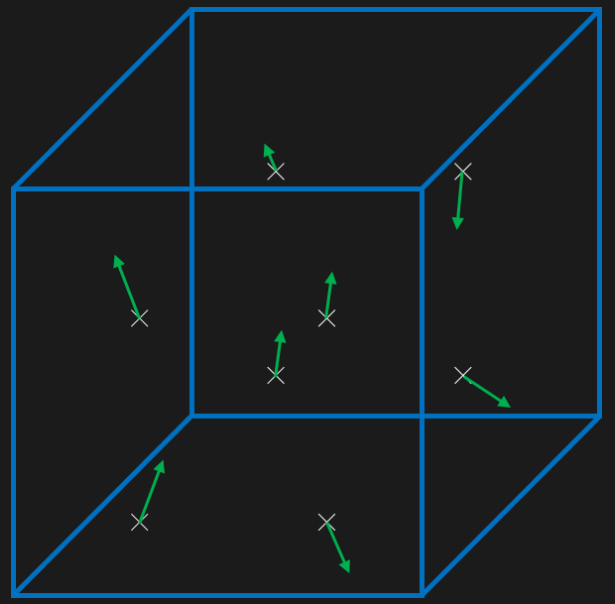


Image acquisition → Segmentation → Meshing

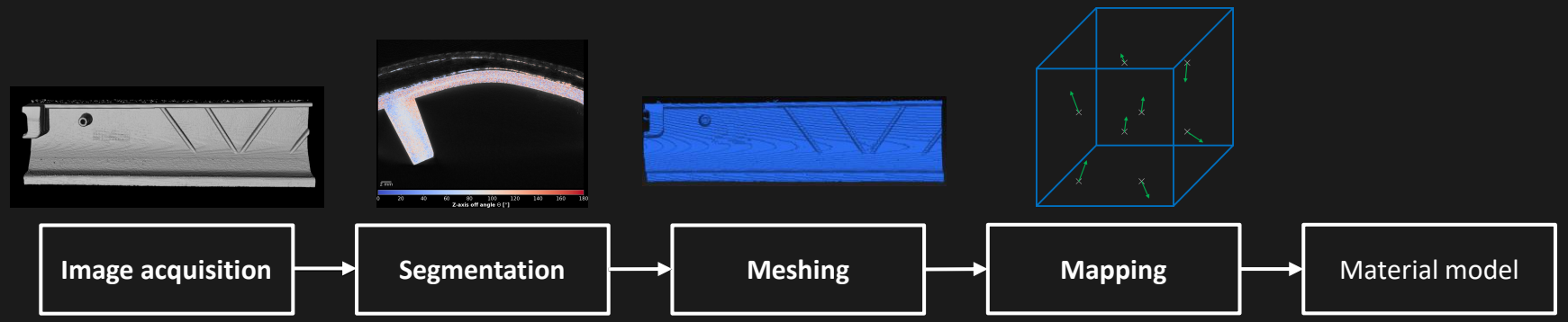


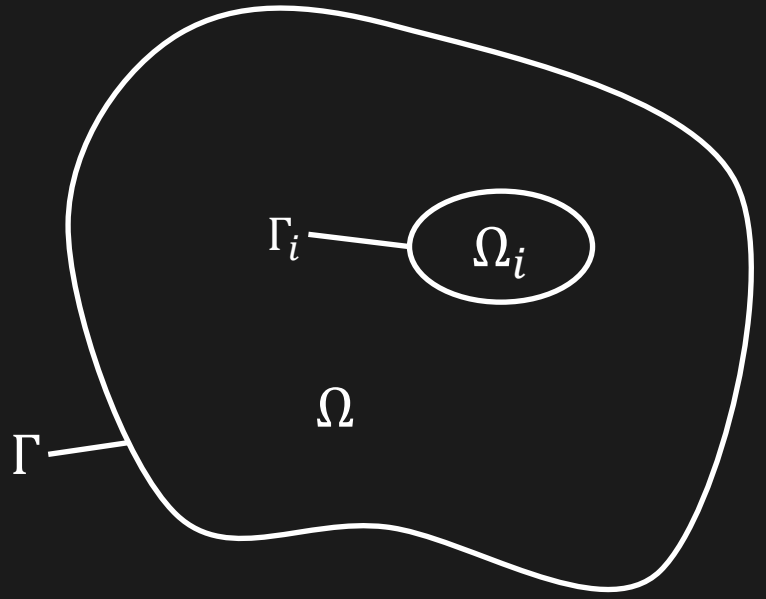
X-ray computed tomography aided engineering (XAE) Process





X-ray computed tomography aided engineering (XAE) Process





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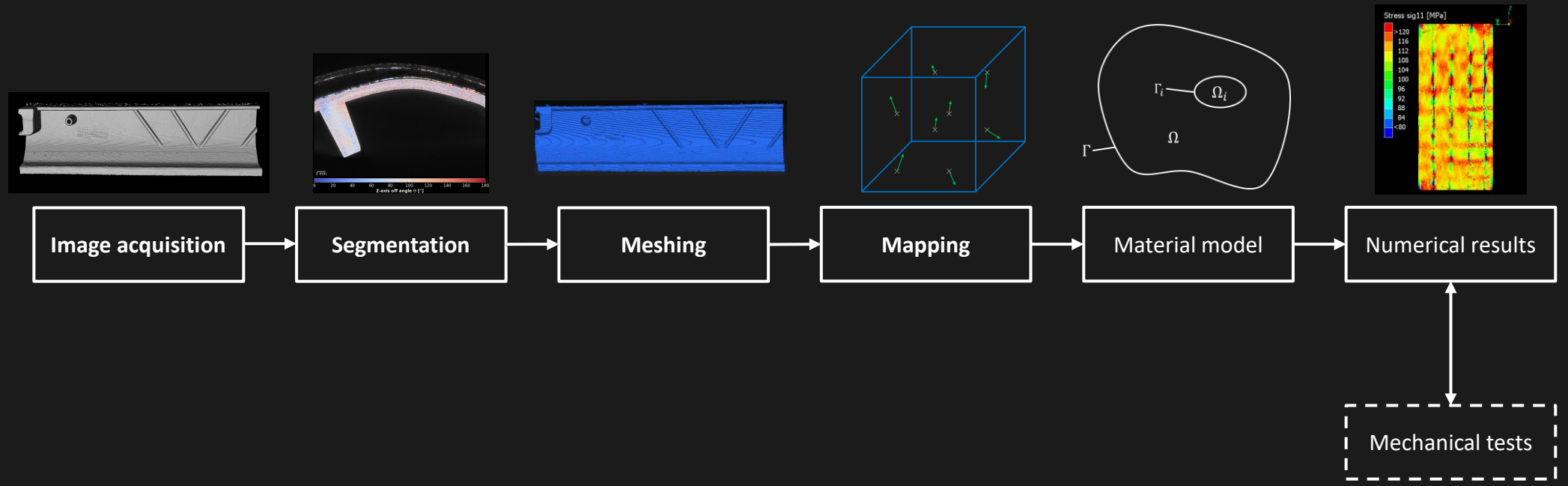
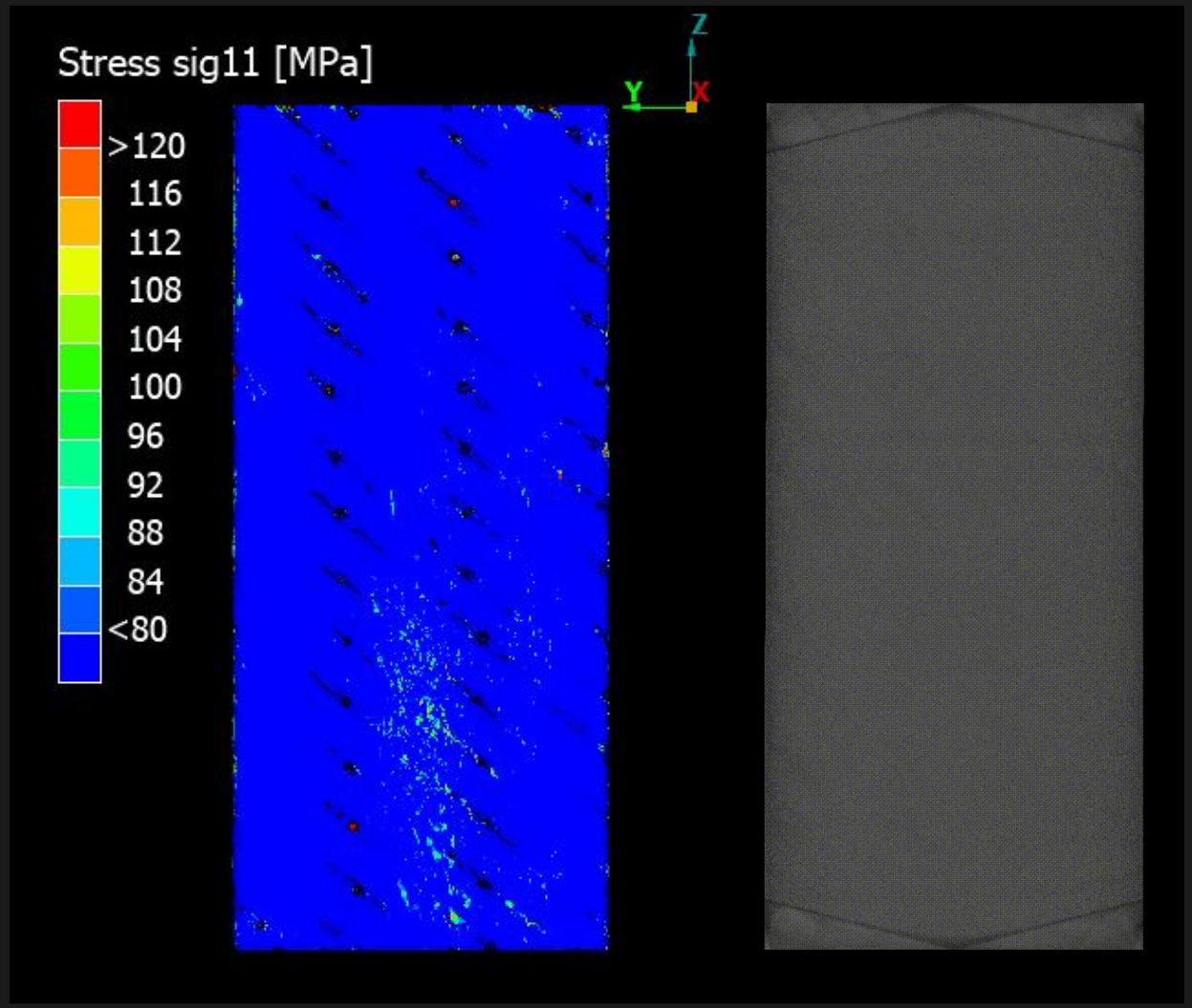


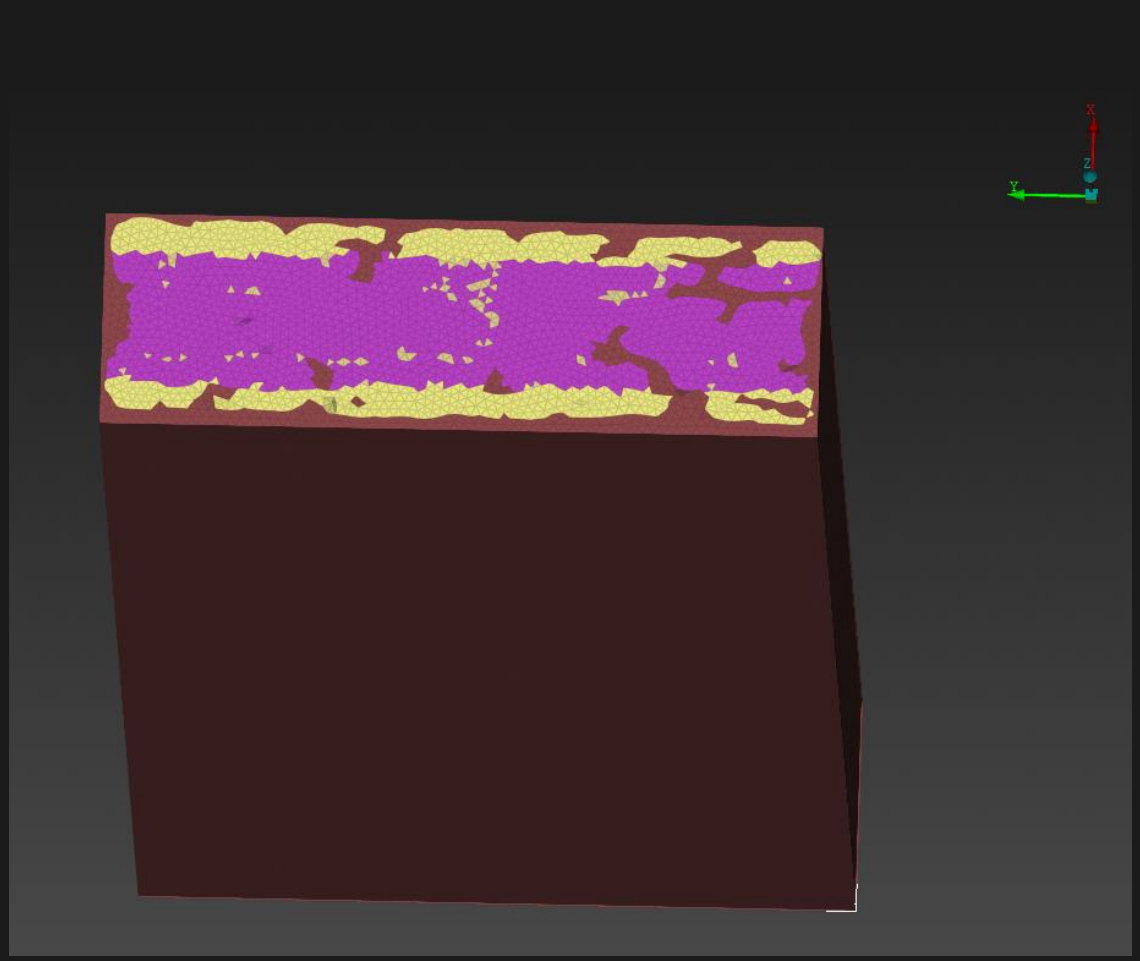
R. M. Auenhammer, L. P. Mikkelsen, L. E. Asp and B. J. Blinzler (2021) Automated x-ray computer tomography segmentation method for finite element analysis of non-crimp fabric reinforced composites, *Composite Structures*, **256**, 113136

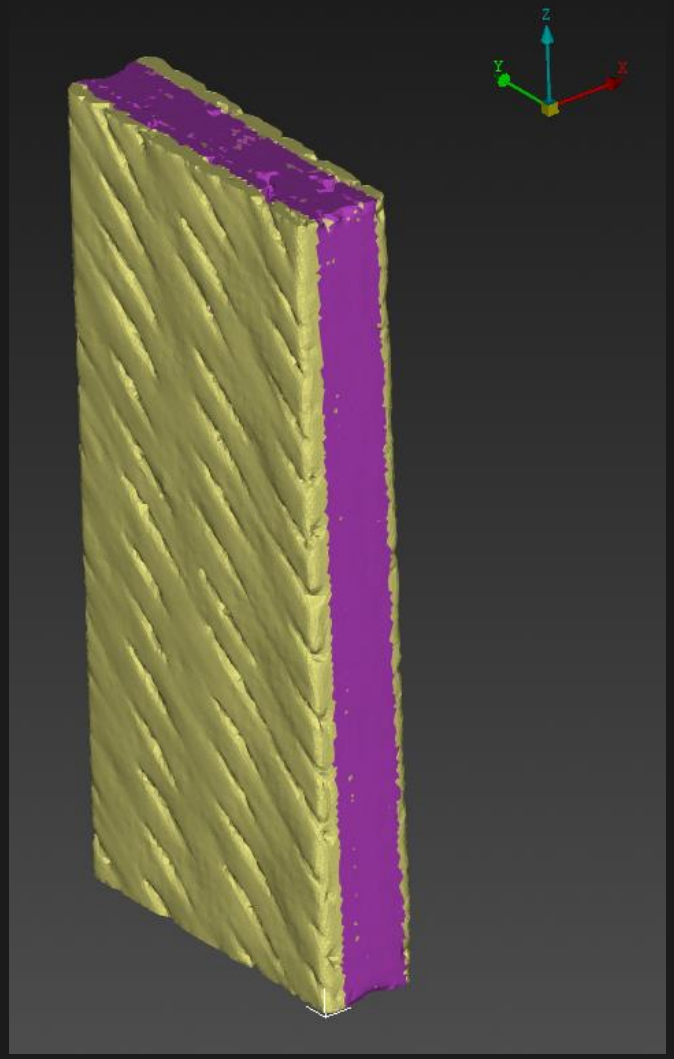
Results



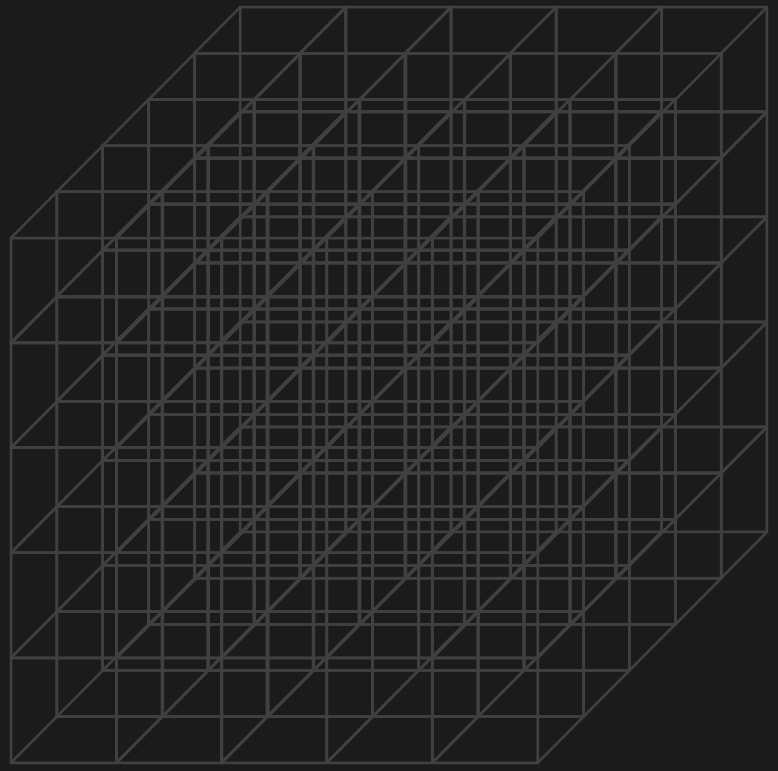
R. M. Auenhammer, N. Jeppesen L. P. Mikkelsen, V. A. Dahl, L.E. Asp. X-ray computed tomography data structure tensor orientation mapping for finite element models — STXAE. Software Impacts 11 (2022), 100216
R. M. Auenhammer, N. Jeppesen, L. P. Mikkelsen, V. A. Dahl, B. J. Blinzler, L. E. Asp. Robust numerical analysis of fibrous composites from X-ray computed tomography image data enabling low resolutions, Composites Science and Technology, 256 (2022) 113136

Feature-dependent meshing

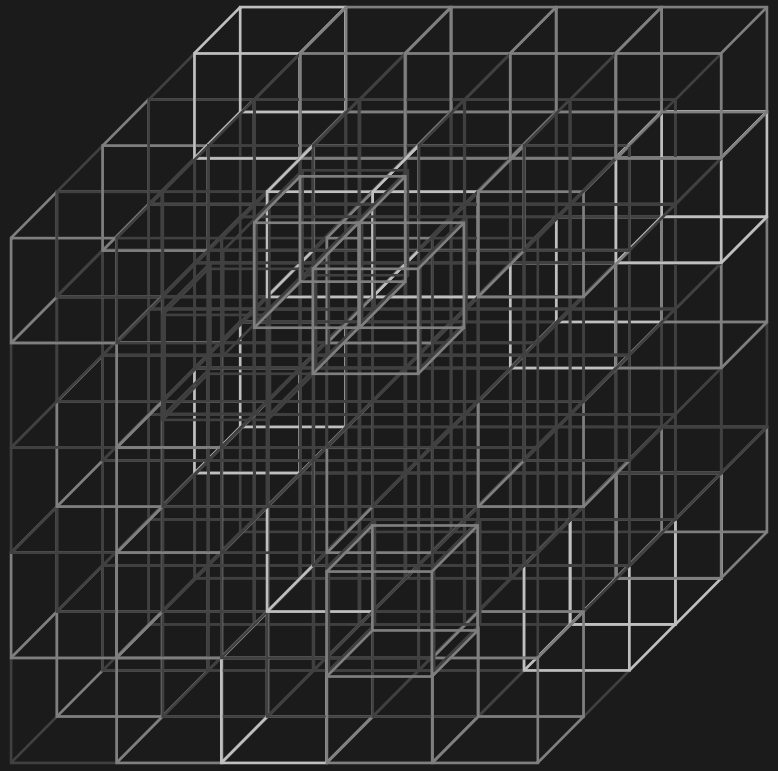




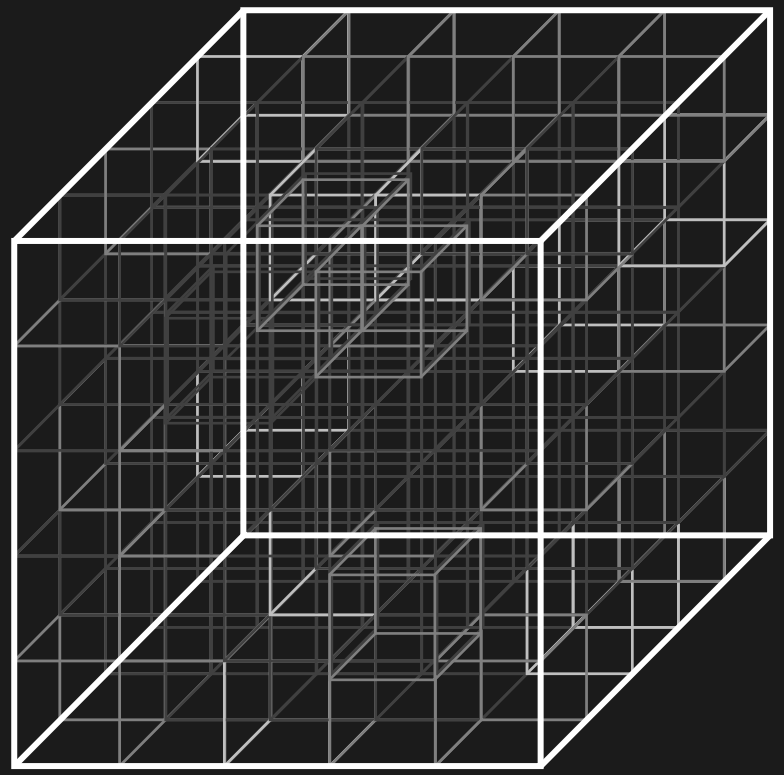
Feature-independent meshing



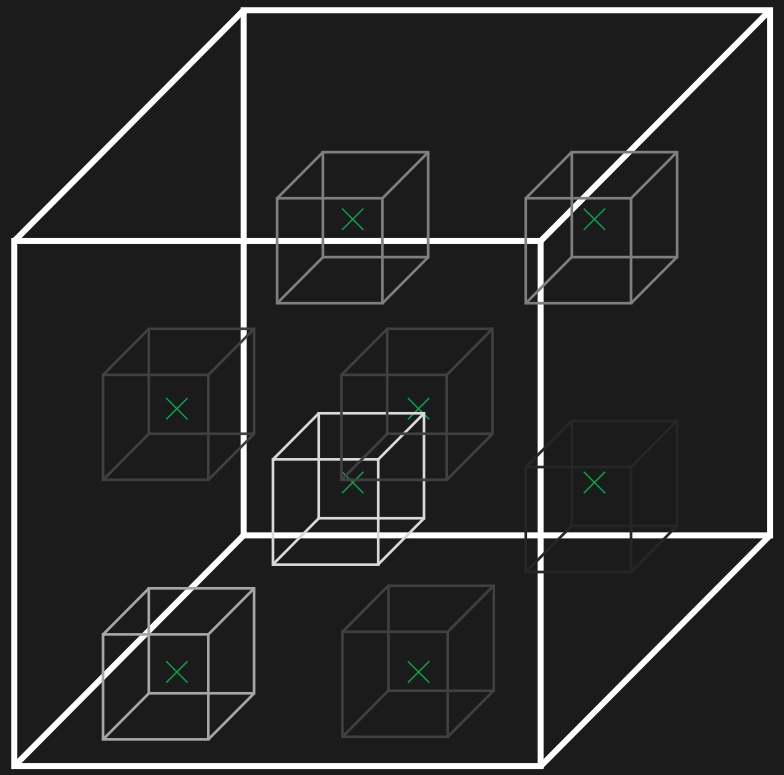
Feature-independent meshing



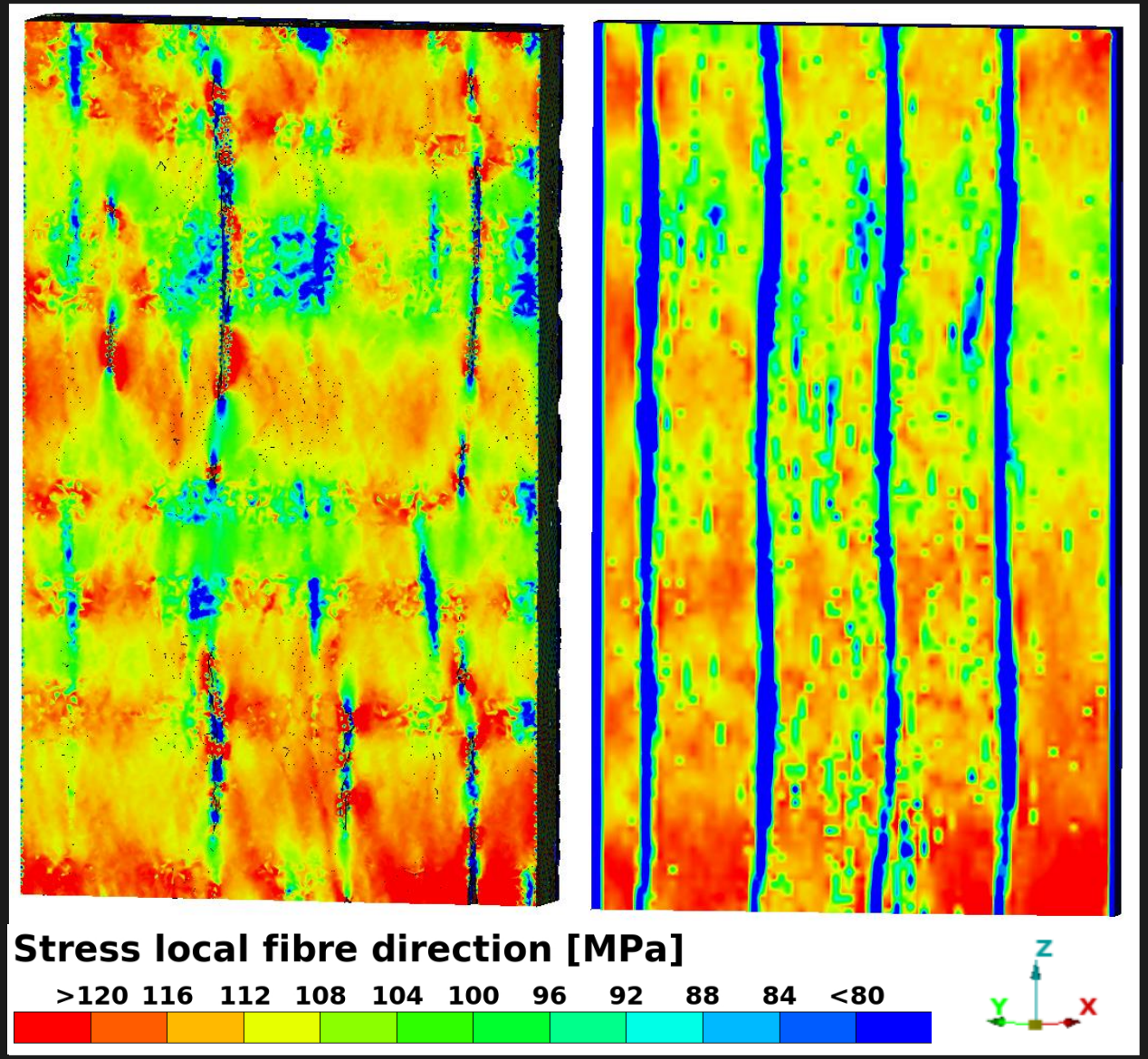
Feature-independent meshing



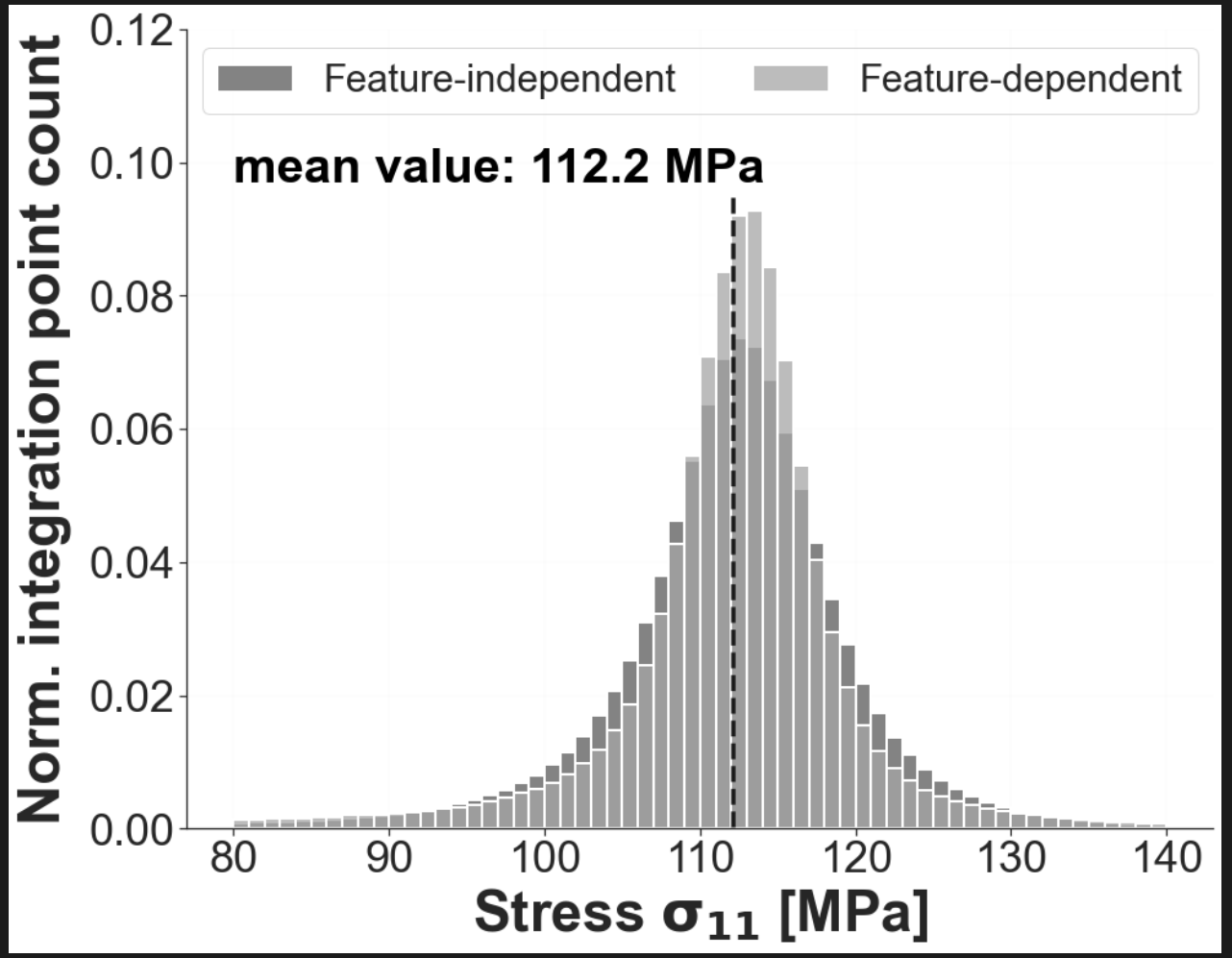
Feature-independent meshing



Stress distribution



Stress histogram



Conclusion

- Image-based modelling adds complexity to the modelling process
- BUT allows for more accurate modelling

- Good match stress histogram

Acknowledgements

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- L. Mikkelsen (DTU)
- R. Gutkin, R. Larsson and L. Asp (Chalmers)

Thanks to my co-authors

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