Machine learning for advanced solar cell production: adversarial denoising, sub-pixel alignment and the digital twin

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Philipp Kunze, Aditya Kovvali,
Alexandra Woernhoer, Stefan Rein

Workshop on ClimateChangeAI
Virtual, NeurIPS 2020

Fraunhofer Institute for Solar Energy Systems ISE
Freiburg, Germany

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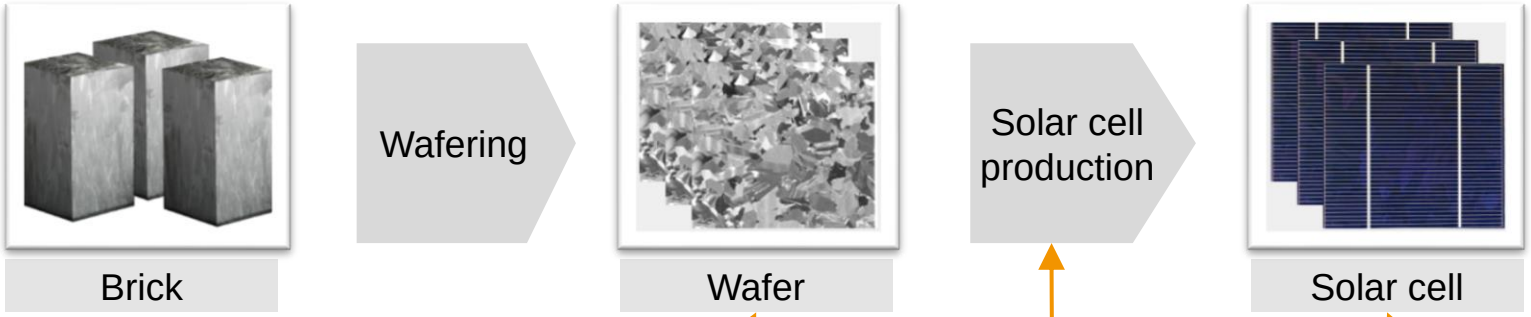
ML USE CASES IN PV-PRODUCTION

Reduce costs **Increase efficiency**



1. Adversarial denoising for material inspection

2. Sub-pixel regression for process alignment

3. Digitial Twinning with representation learning for solar cell analysis

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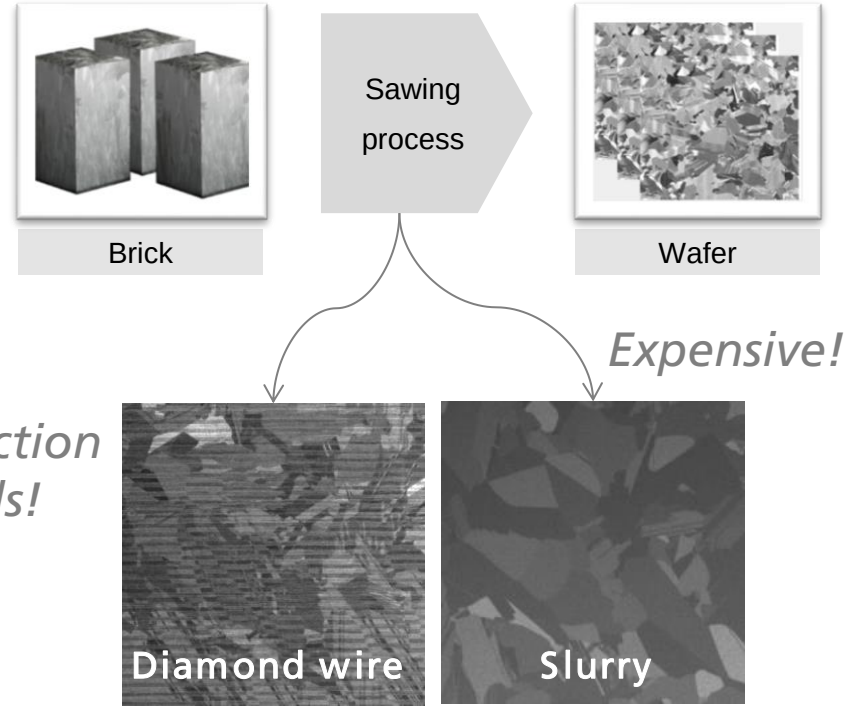
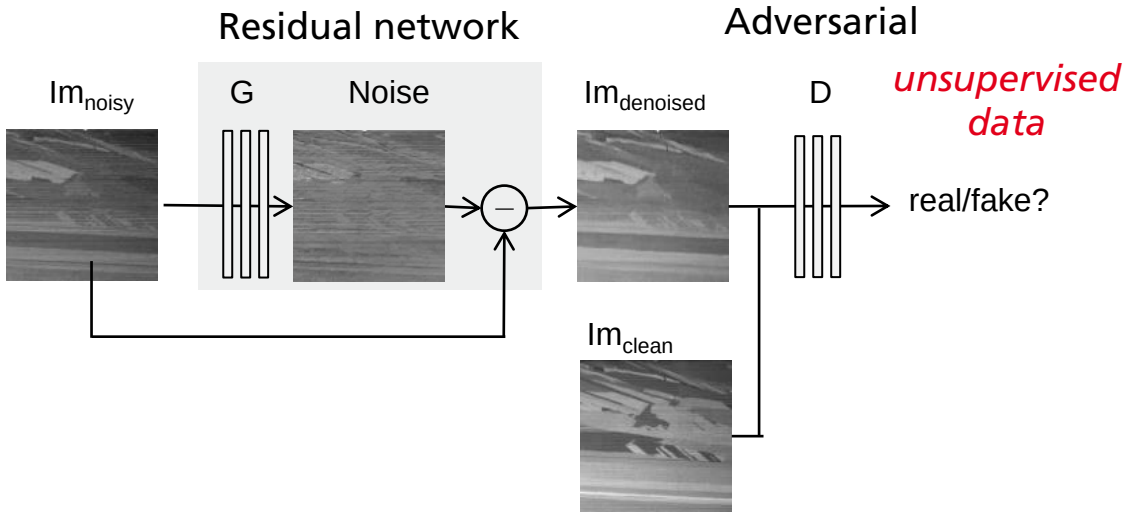
Adversarial denoising
Wafer inspection



Denoising ResGAN



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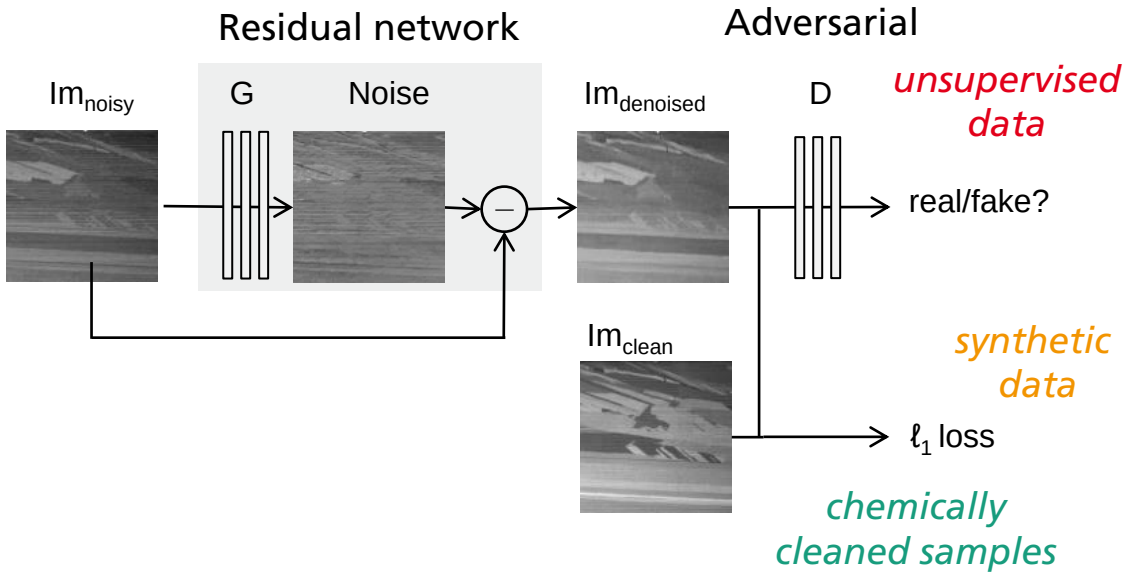
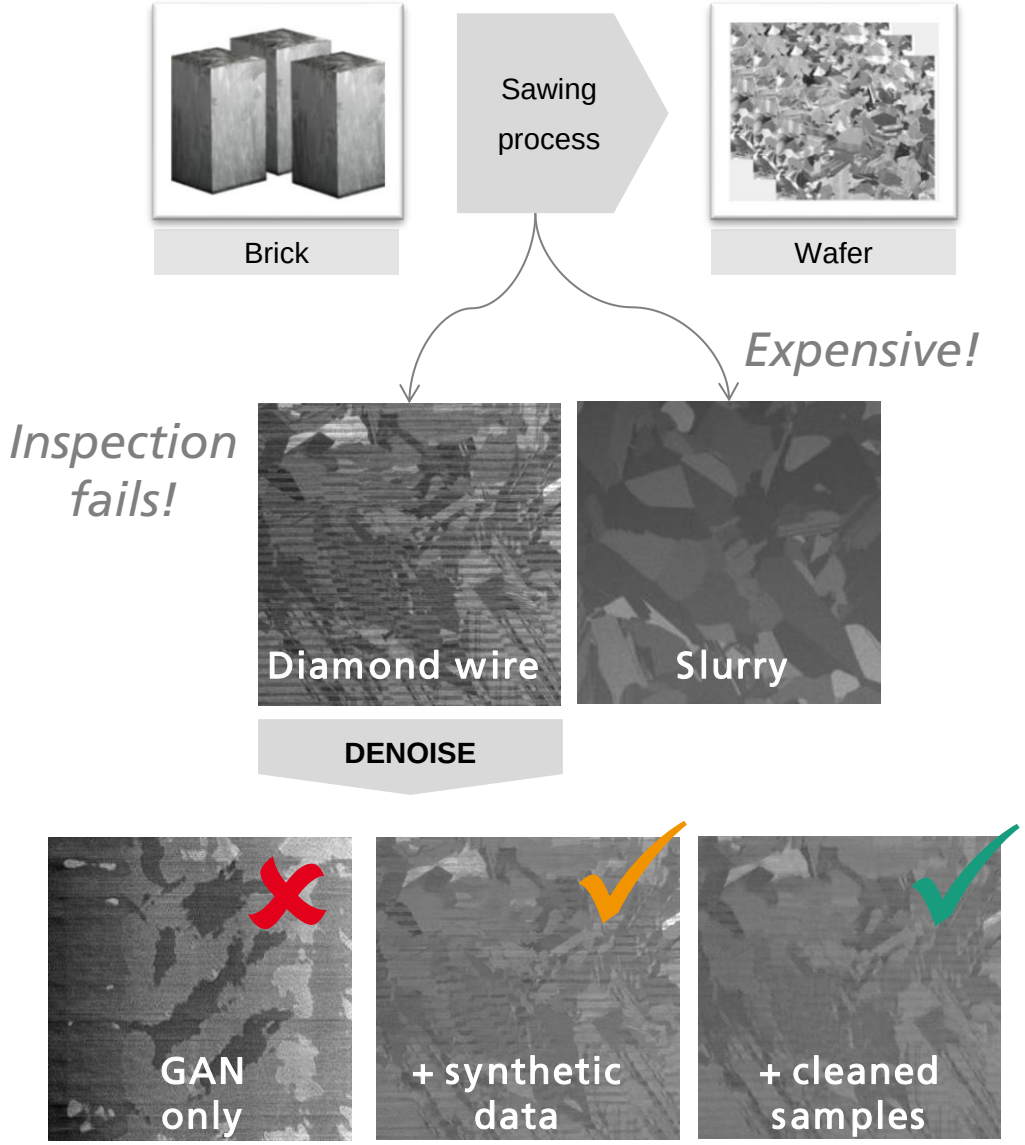
Adversarial denoising
Wafer inspection

Denoising ResGAN





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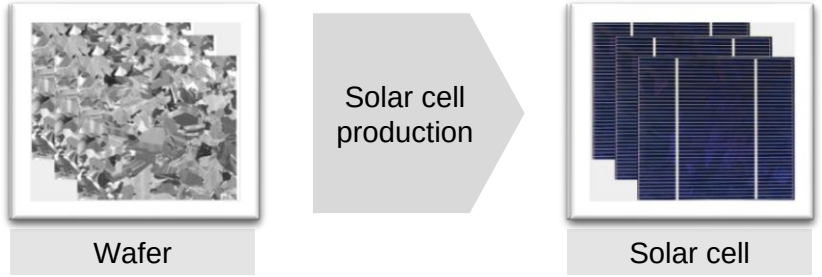
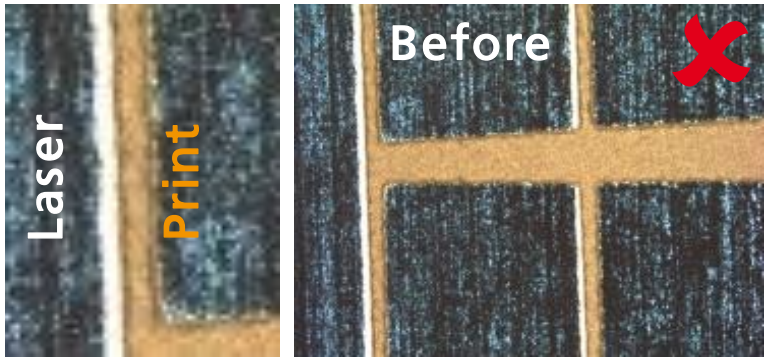
Subpixel alignment

Solar cell production with selective emitter





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*A. Nibali, et al., arXiv:1801.07372v1

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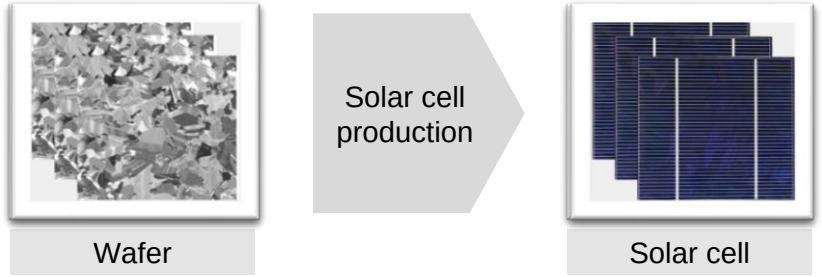
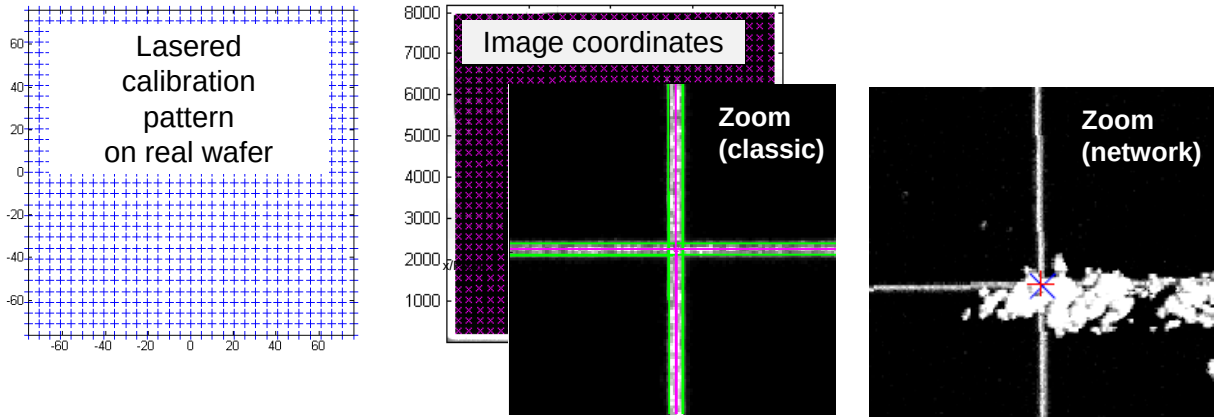
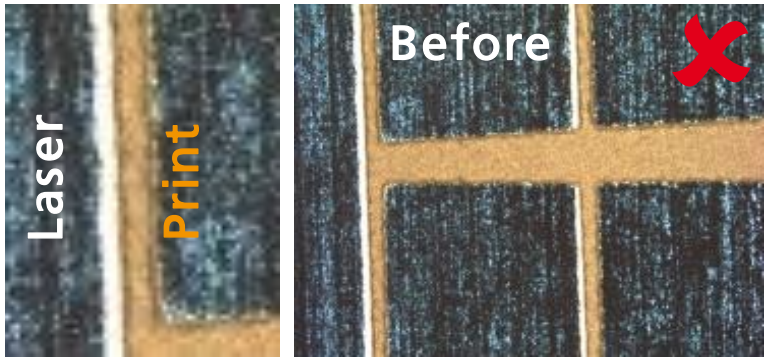
Subpixel alignment

Solar cell production with selective emitter

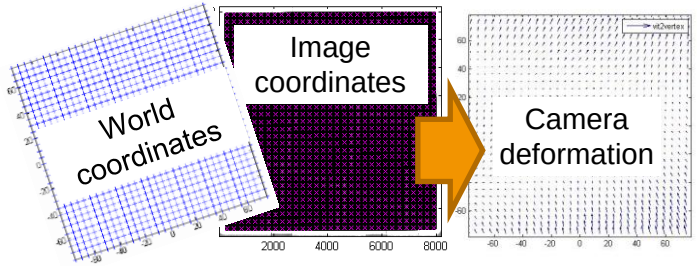


CNN for subpixel coordinate regression*

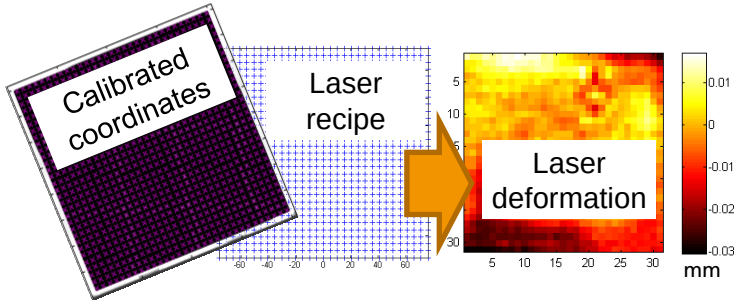




Camera calibration



Laser deformation



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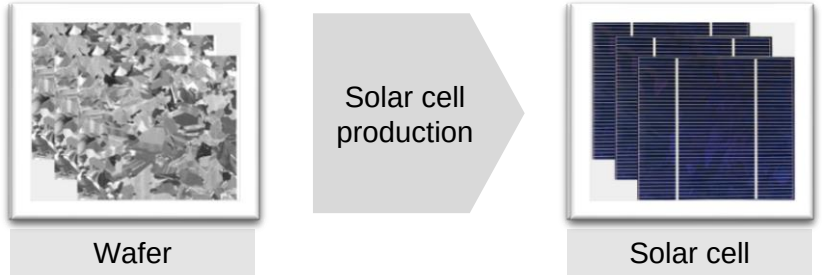

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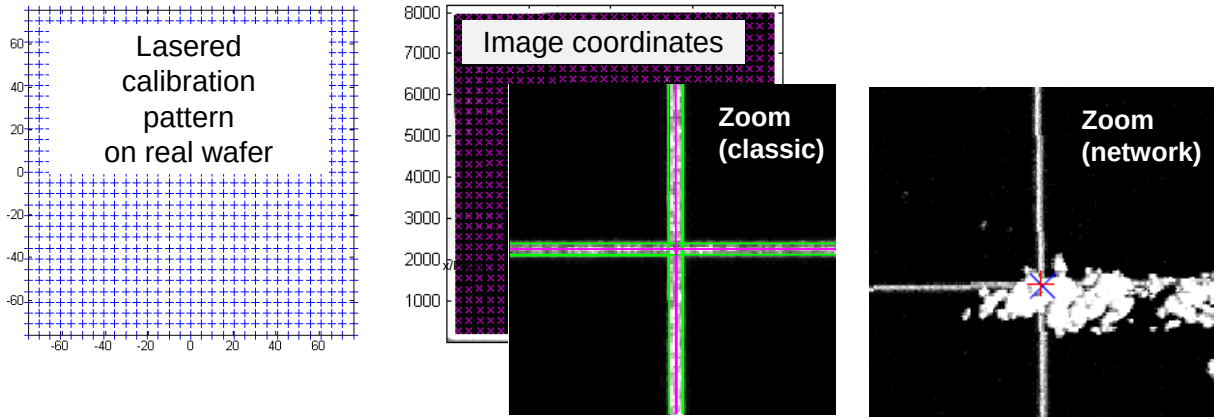

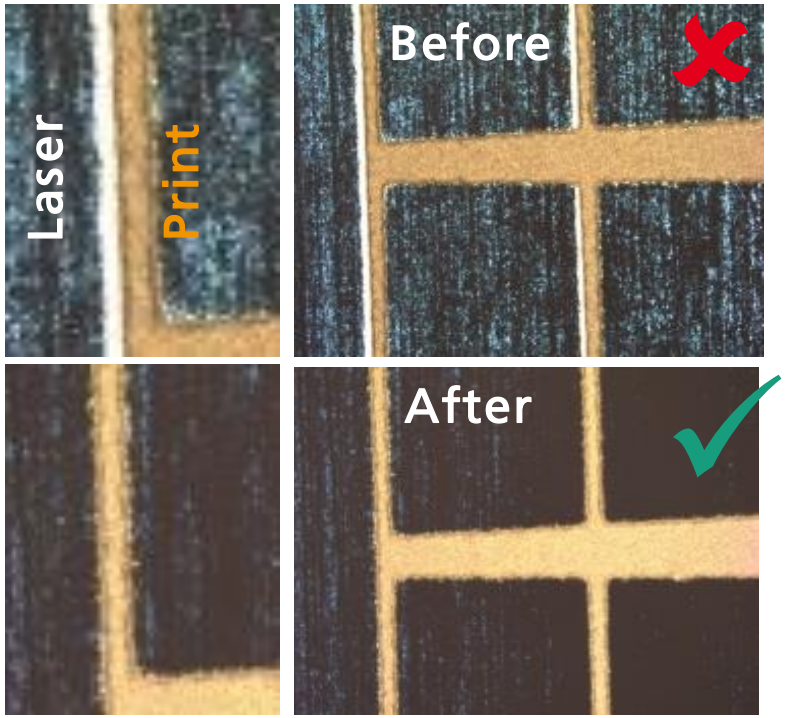

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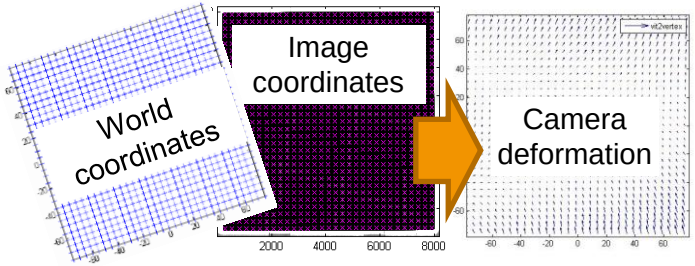

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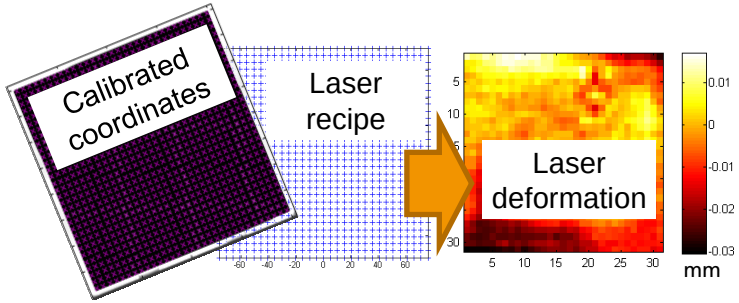

+0.3%$_{abs}$ solar cell efficiency

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Digital Twinning
Solar cell analysis

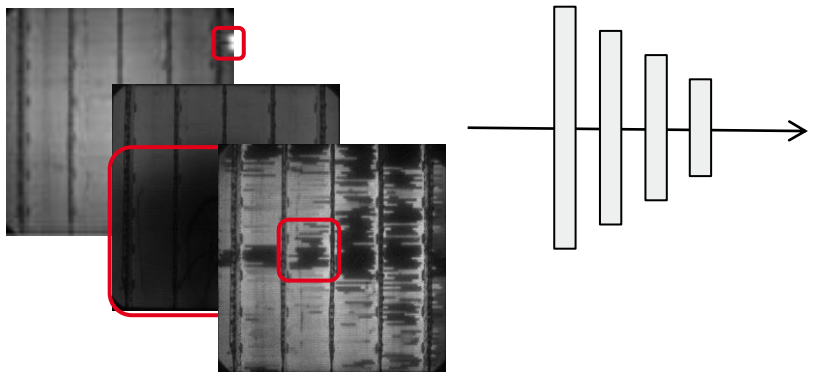
Solar cell

Representation learning

Imaging techniques

Regression CNN

Solar cell parameters



V_{oc} (*Volt*)

η (%)

FF (%)

J_{sc} (A)

Different material & process defects

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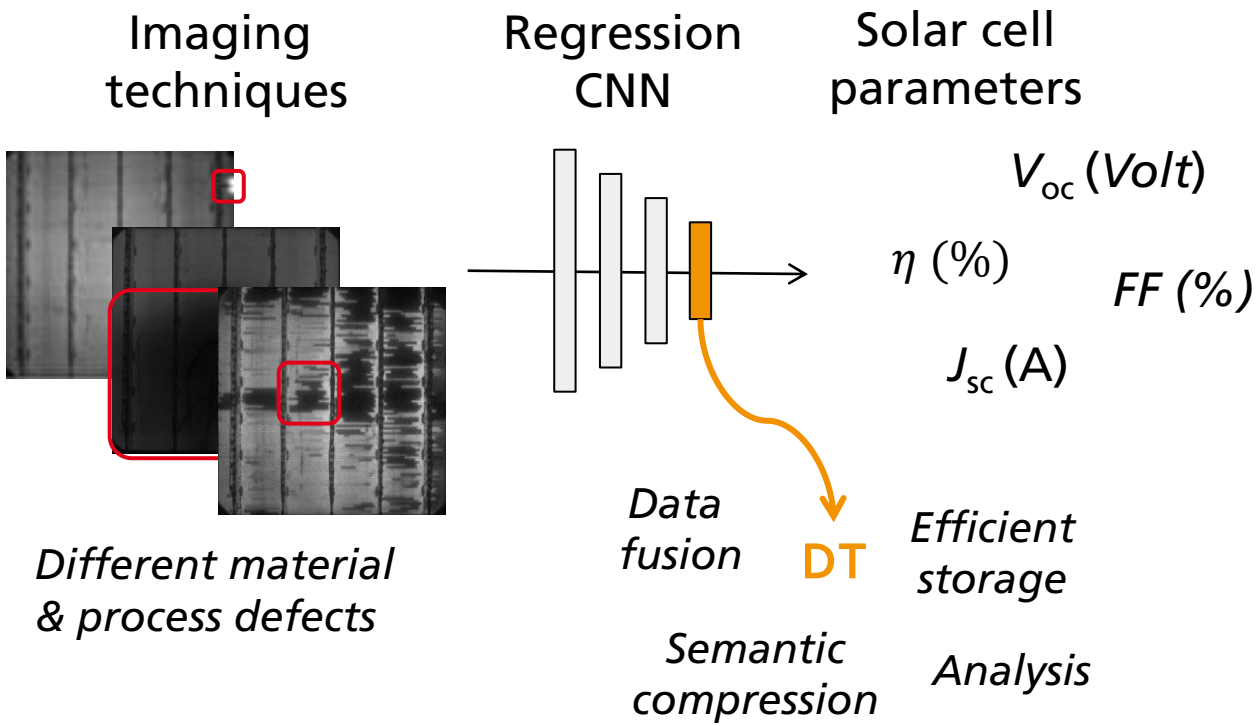
Solar cell analysis

Solar cell

Representation learning



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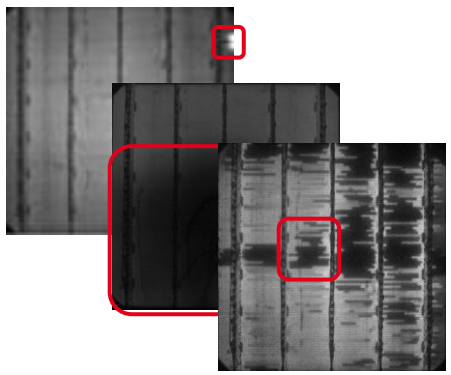
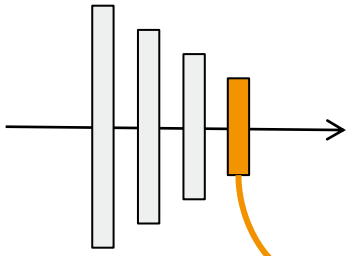




V_{oc} (*Volt*)

η (%)

FF (%)

J_{sc} (A)

Different material & process defects

Data fusion

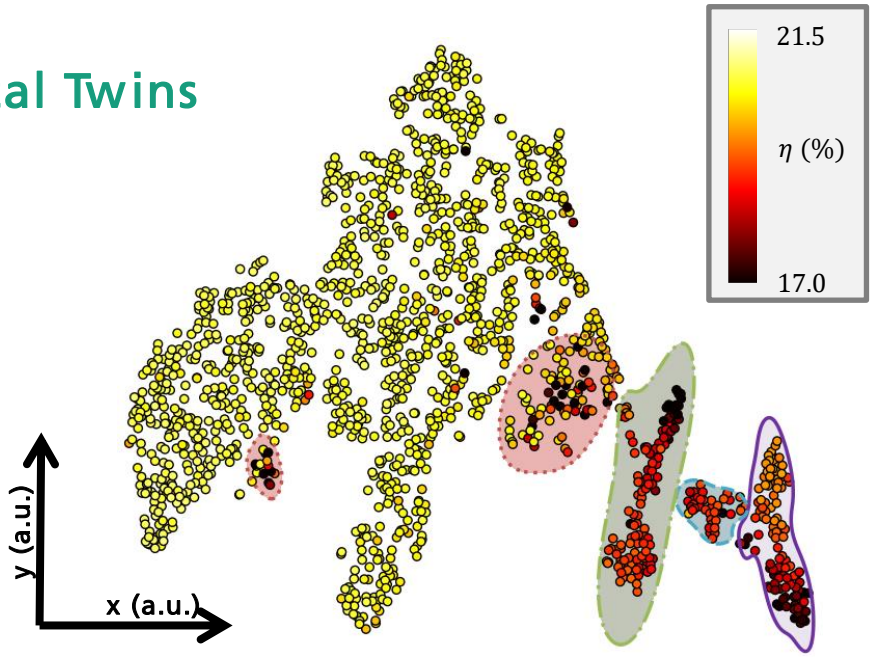
DT

Efficient storage

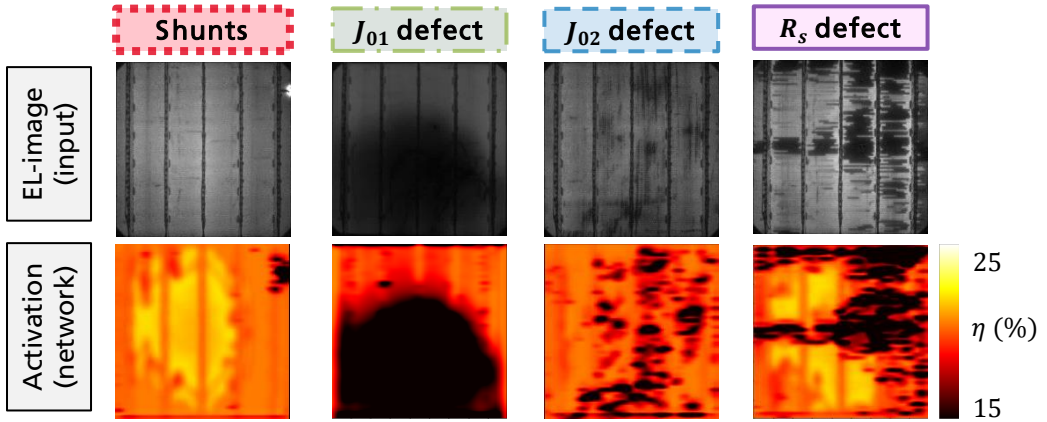
Semantic compression

Analysis

Digital Twins



Analysis



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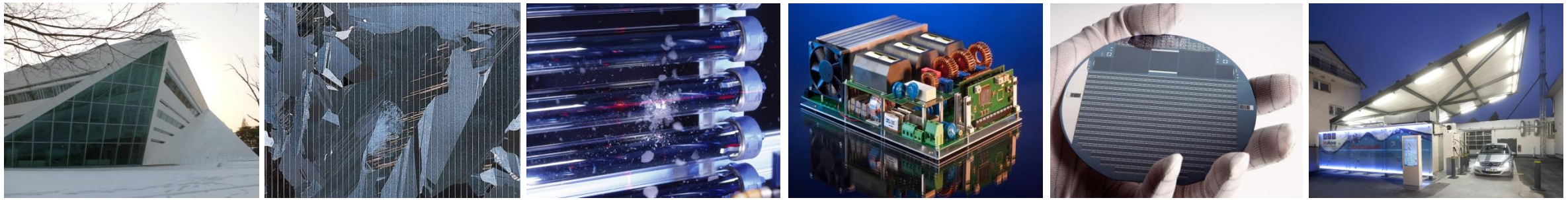
Thank you for your Attention!



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