IPI IMAGE PROCESSING AND INTERPRETATION | GHENT UNIVERSITY
UAV Research Centre

BLADE EROSION QUANTIFICATION BY DRONE-CAPTURED HIGH-RESOLUTION IMAGES

FACULTY OF ENGINEERING AND ARCHITECTURE

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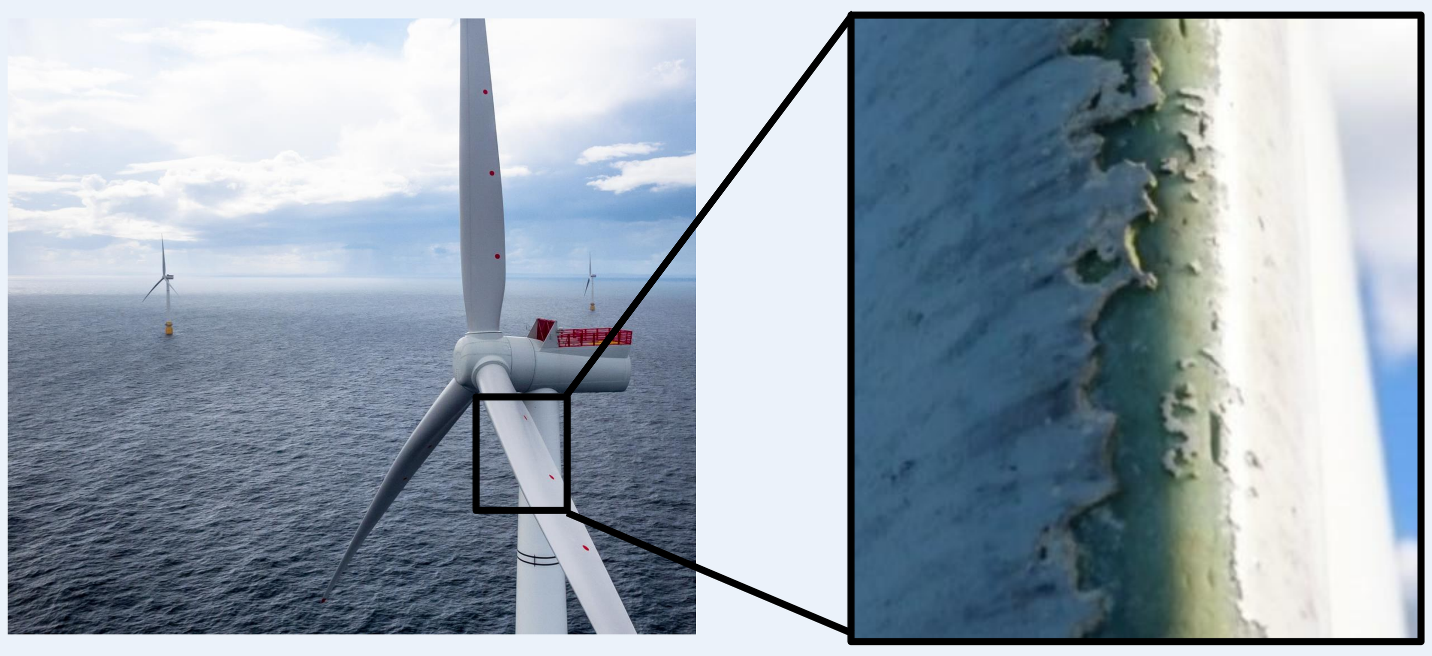
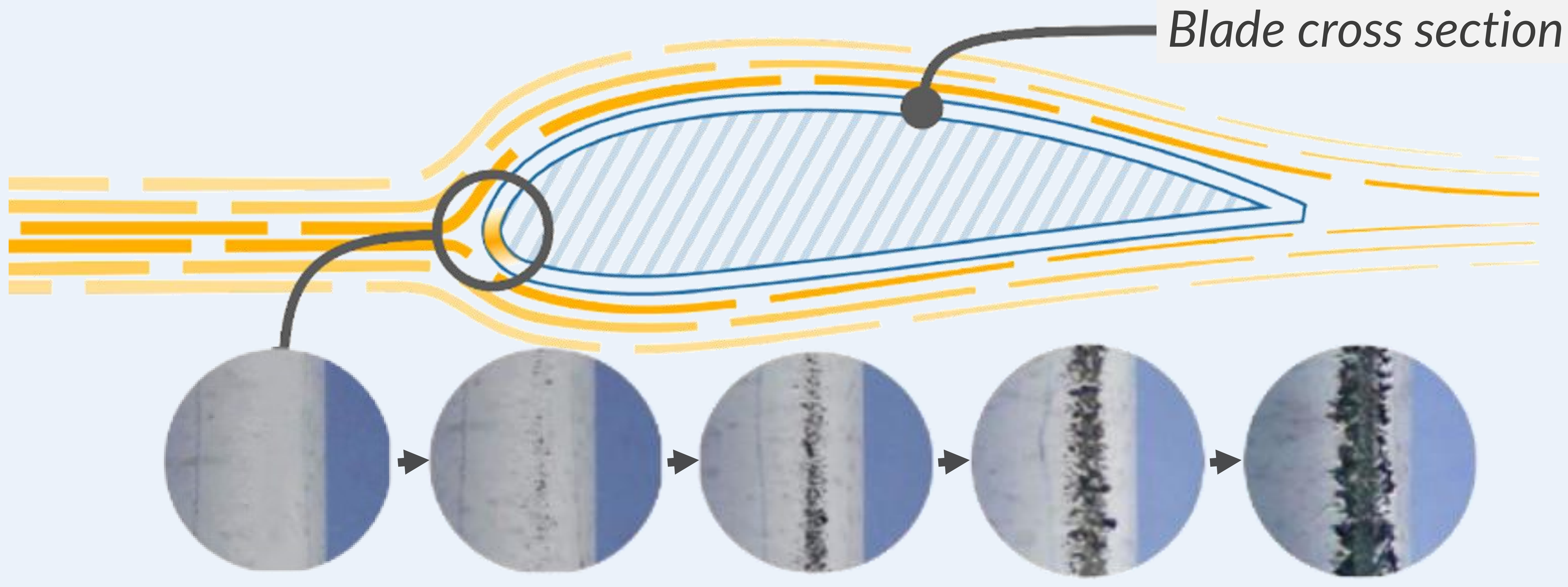
MOTIVATION



BACKGROUND

Air and water particles hit the leading edge at high speeds, causing erosion over time. The aerodynamic efficiency and lifetime of the blades is reduced, and energy is lost.



OBJECTIVE

Obtaining a sub-mm accurate 3D model of the leading edge, followed by quantifying erosion on wind turbine blades.

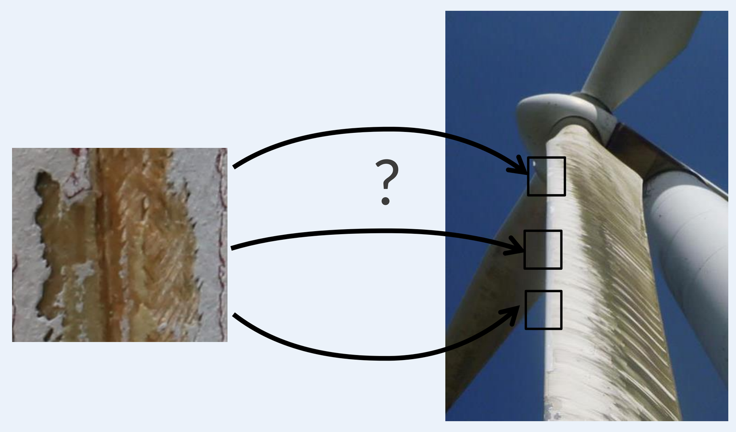
CHALLENGES

OBTAINING SHARP IMAGES

Wind → motion of drone and blade → blur
Even if turbine is turned off, the blades still move.

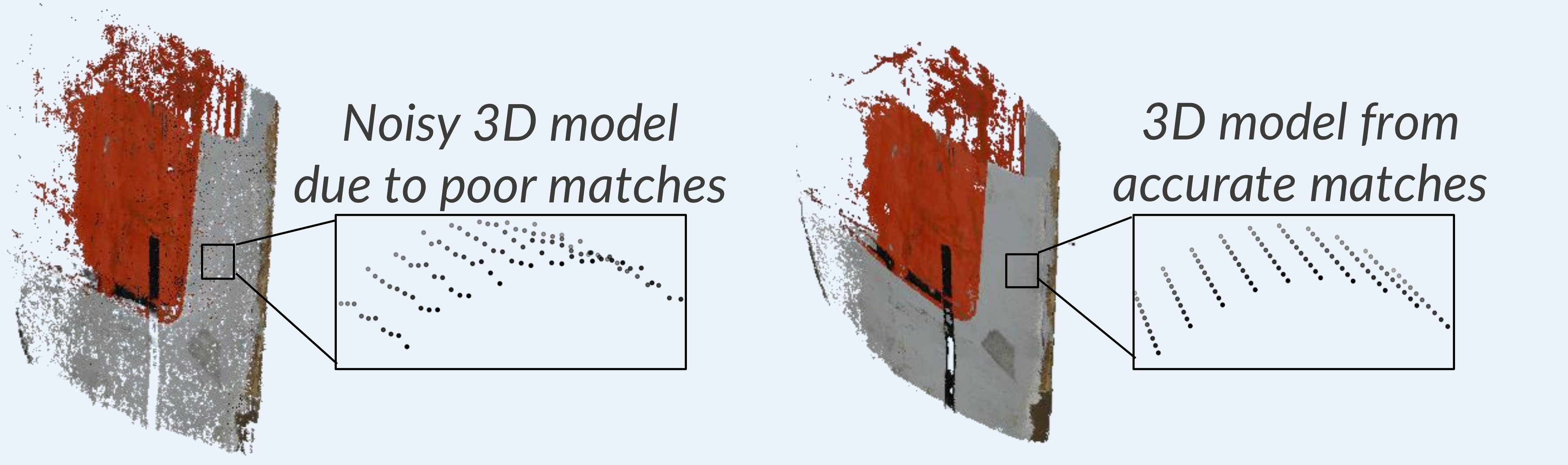
LOCALIZING DEFECTS

Close-up images show the defects, but not where they are.



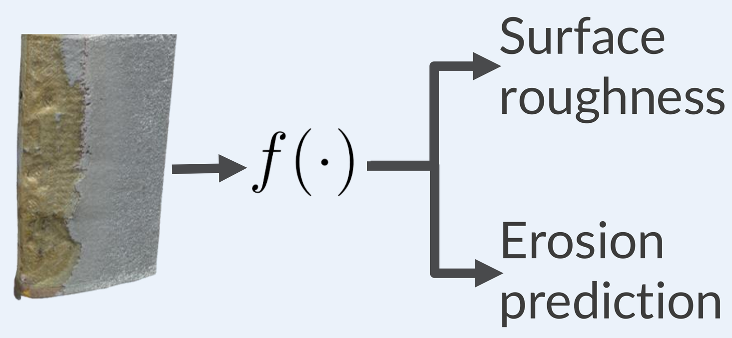
ACCURATE 3D RECONSTRUCTION

Requires many unique keypoints & sub-pixel accurate matches.



EFFICIENTLY QUANTIFYING WEAR

Existing neural networks can not efficiently process 3D point clouds.



WORKFLOW

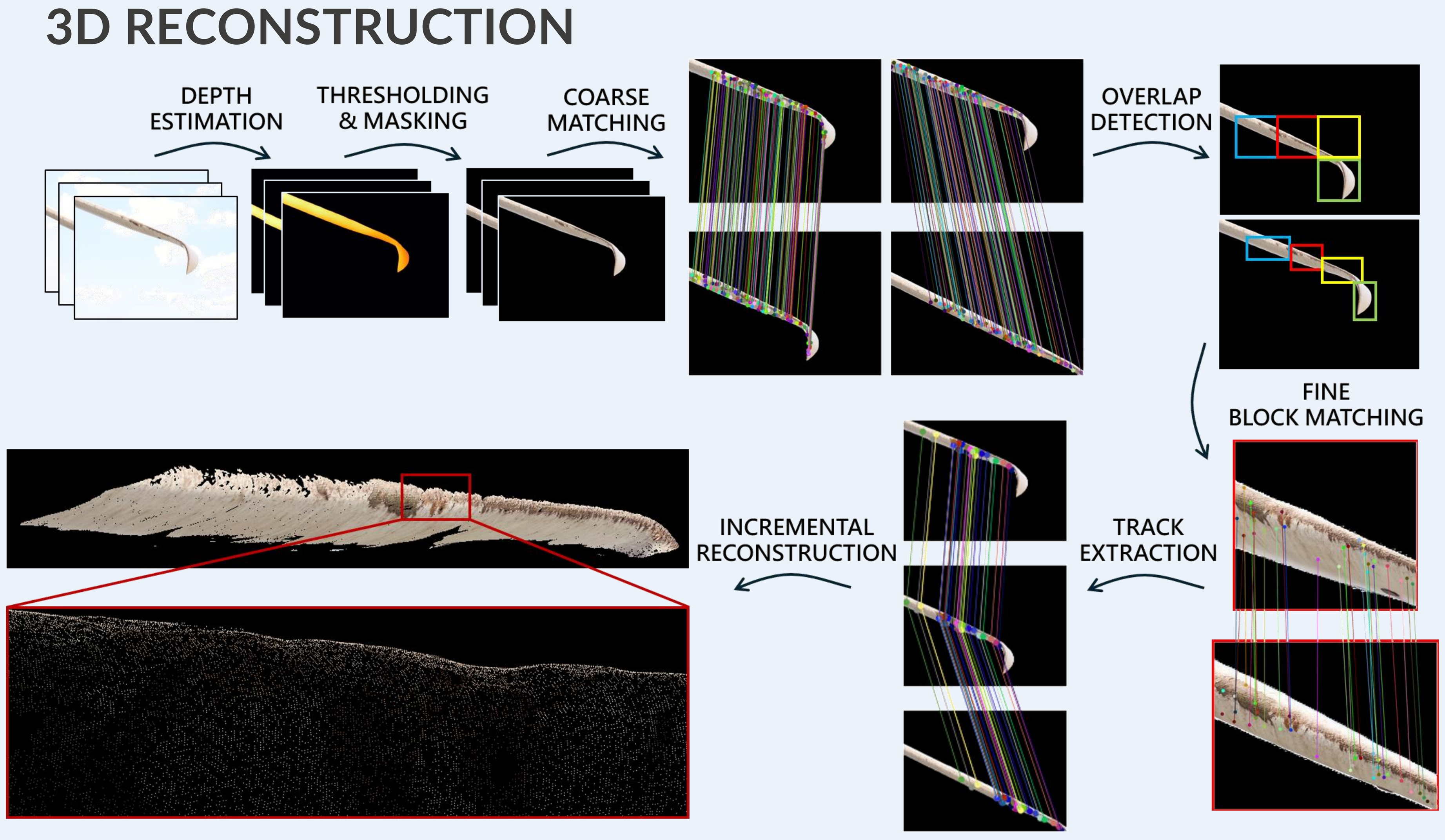
IMAGE CAPTURE

HDR:
sharp & noiseless images

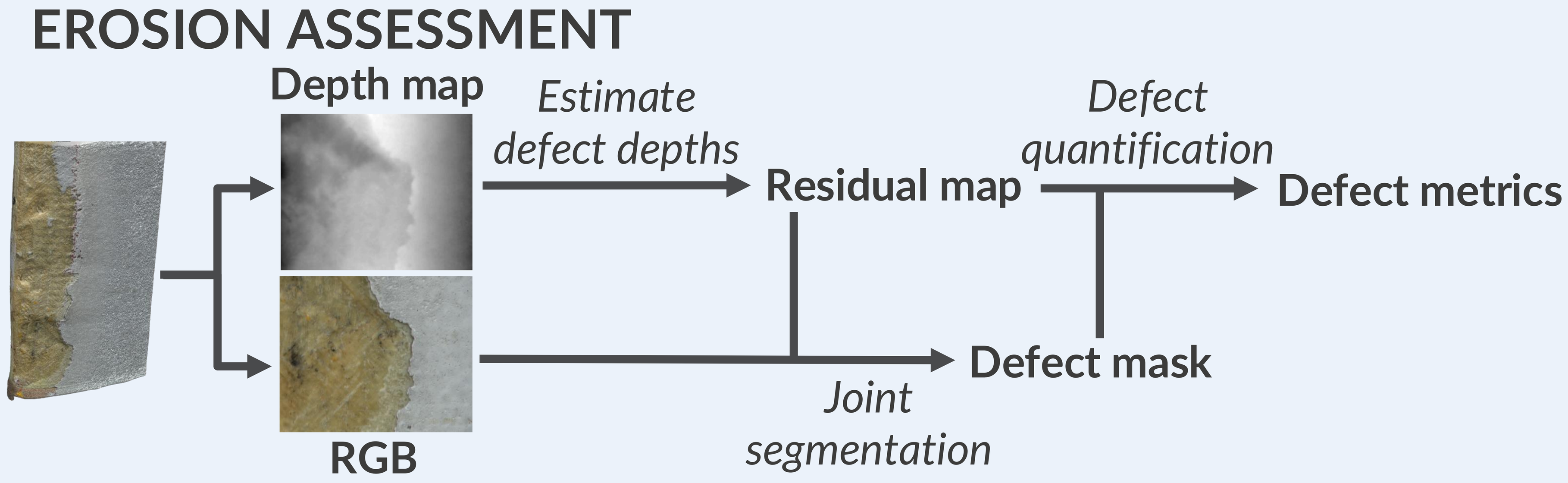
Short exposure — Low blur
Long exposure — Low noise

LiDAR + SLAM:
localizes the drone
=> easy localization of images

3D RECONSTRUCTION

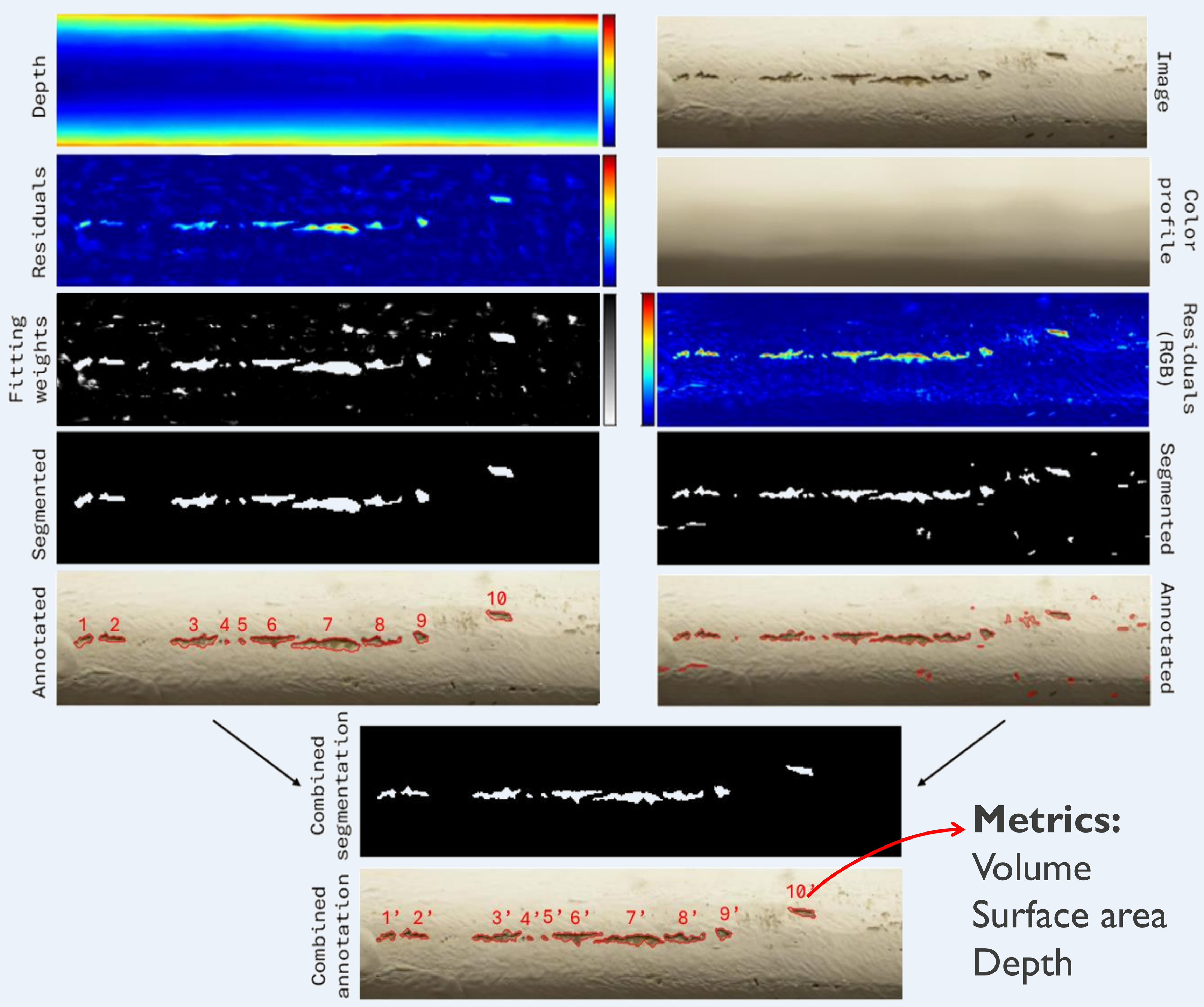


EROSION ASSESSMENT



RESULTS

- **Improved 3D reconstruction**:
  Robust against failure cases of standard approaches
  >38% lower reprojection error, 100% model density (vs. ~40%)
- **Accurate defect quantification**:
  RGB & 3D fusion resolves visual ambiguities
  Provides accurate, physical defect metrics



- **Future work**:
  Integrating deblurring in the 3D reconstruction
  Tracking defects across multiple inspections

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