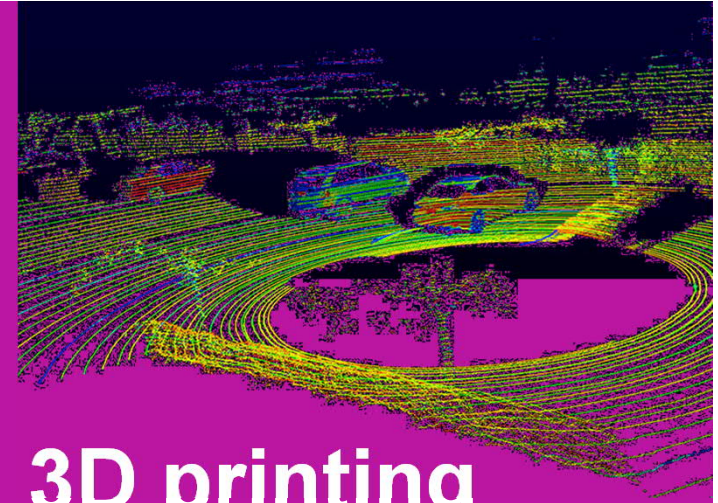


FI Tech Summer Boost: Additive Manufacturing and 3D printing 3D Scanning Opportunities



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Brief Intro.

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Aalto University
School of Engineering



Ph.D. topic: *Implementation of Industrial additive manufacturing*

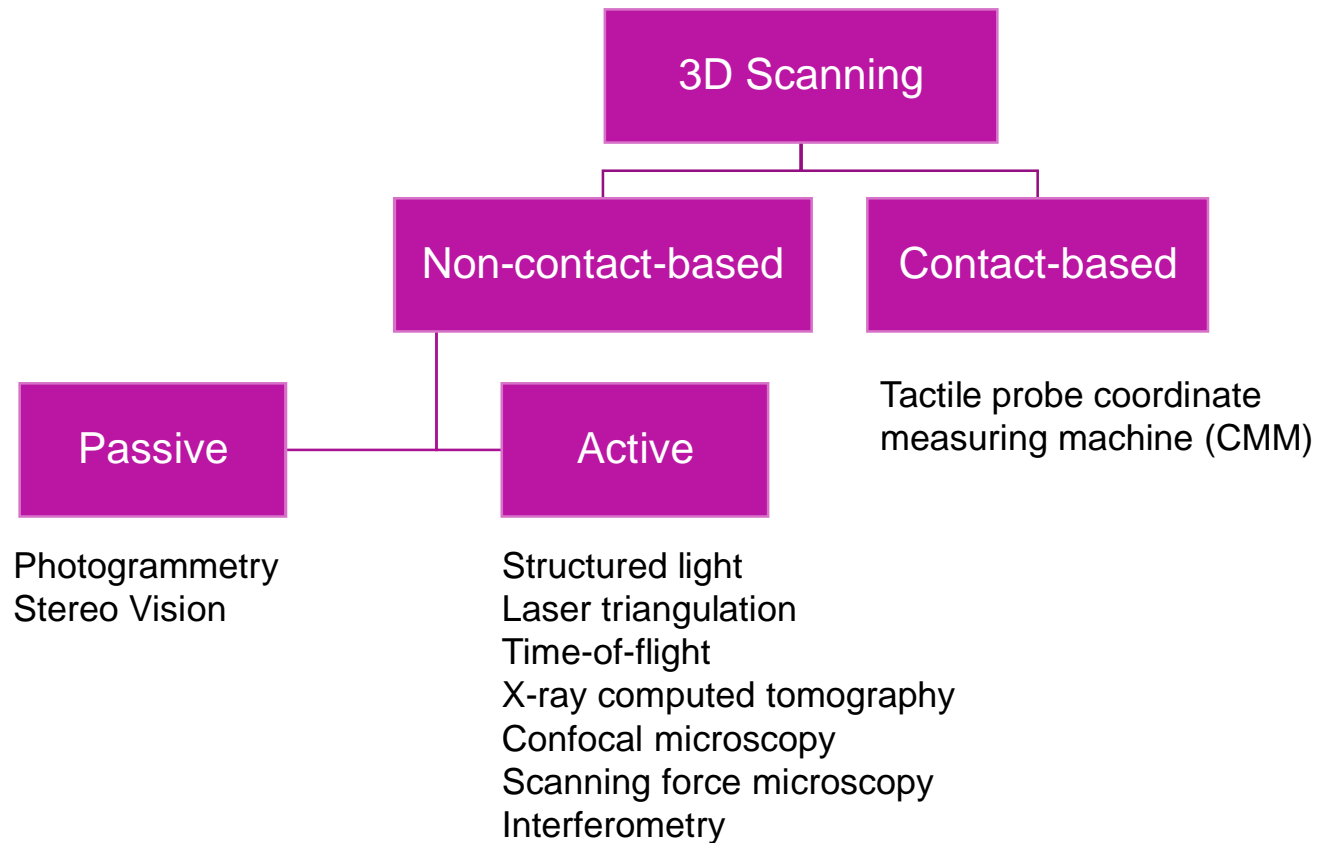
“The aim of this talk is to familiarize you with 3D Scanning opportunities that may assist you in ideation, design, and prototyping of your product.”

Content

- **Methods & opportunities**
- **Method selection guidelines**
- **Application workflows**
- **Example video**
- **Scanning demo**

3D Scanning: Methods & Opportunities

Methods & opportunities



Photogrammetry

Technique: Aerial and terrestrial (close-range) computer vision

Category: passive

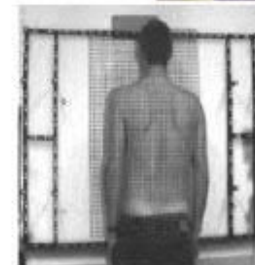
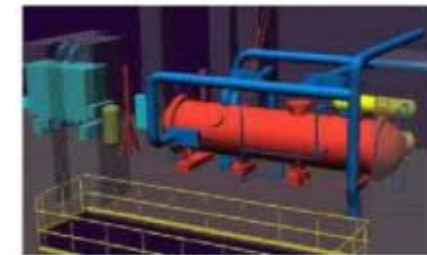
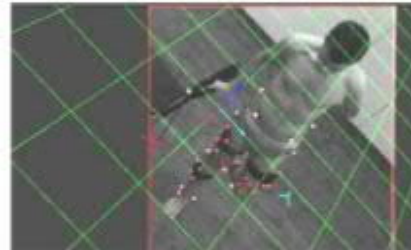
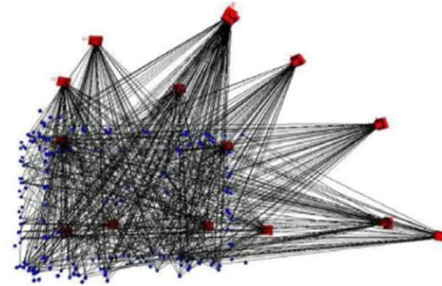
Range: CR ~0.5 to 220 m

Geometry analysis: exterior

Applications: 3D reconstruction

→ topographic maps and detail dimensional information (deformation, deflection, fracture) of an object.

Companies: Matterport, geomatics, Zeiss, etc.



Stereo vision & Structured light

Technique: Camera-camera and camera-projector triangulation

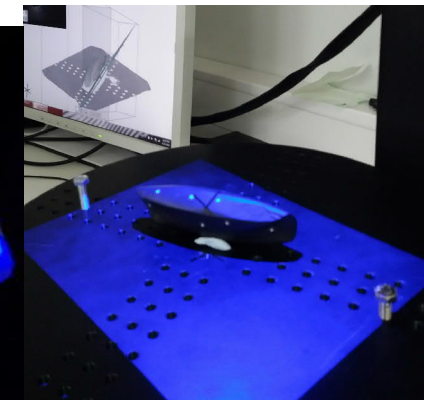
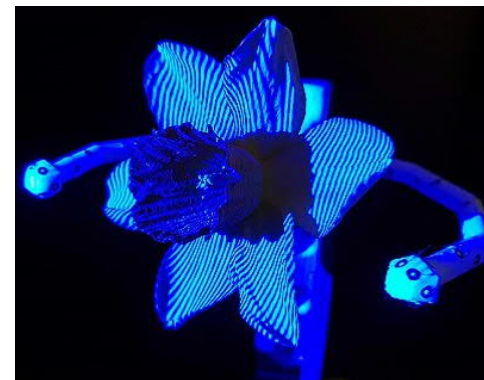
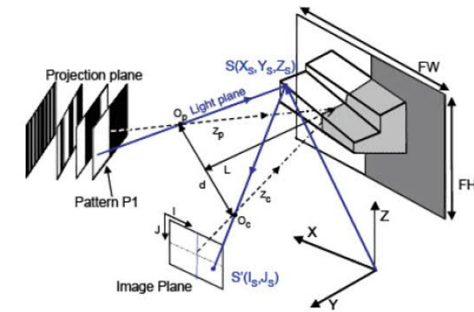
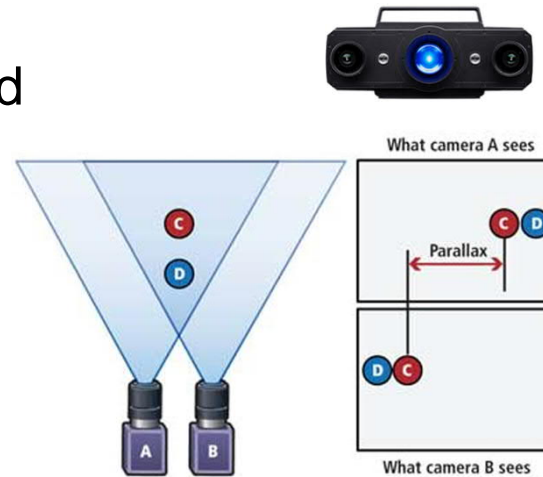
Category: passive & active

Range: ~0.3 – 2 m

Geometry analysis: exterior

Applications: 3D reconstruction
→ Metrology, quality control and reverse engineering

Companies: GOM, Zeiss, Artec3D, 3D systems, etc.



Laser triangulation

Technique: 1D/2D laser triangulation

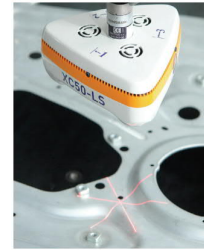
Category: Active

Range: ~0.1 – 6 m

Geometry analysis: exterior

Applications: 3D reconstruction
→ automotive, metal processing,
reverse engineering and quality control

Companies: FARO, 3D digital Corp,
Creaform, Nikon metrology, etc.



Time of flight

Technique: Light, laser or sound time-of-flight (LIDAR)

Category: Active

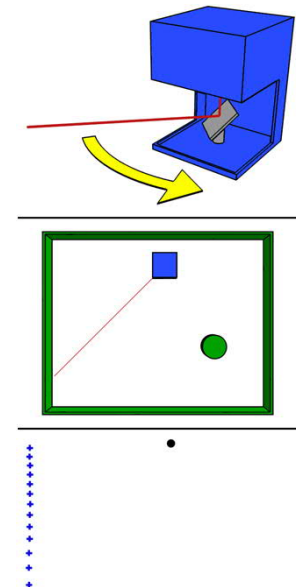
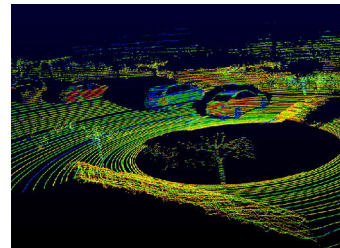
Range: ~0.1 – 120 m

Geometry analysis: exterior

Applications: 3D reconstruction

→ Mid. to large size parts such as wind turbines, ship propellers, airplanes and buildings.

Companies: Artec3D, FARO, Surphaser, etc.



Computed tomography

Technique: X-ray tomography

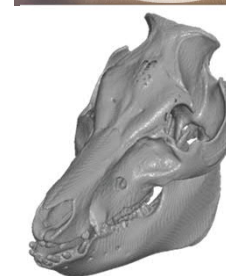
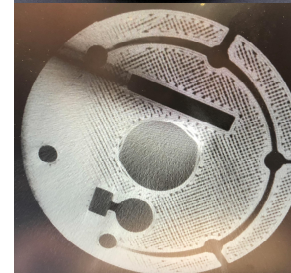
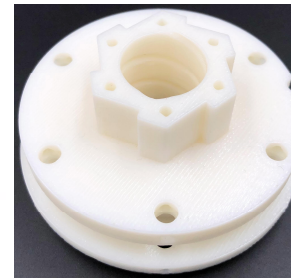
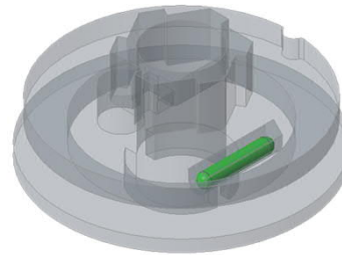
Category: Active

Range: ~0.155 – 1.2 m

Geometry analysis: Interior & exterior

Applications: 3D reconstruction → Medical imaging and non-destructive testing for quality control

Companies: Werth, GOM, Nikon Metrology, NSI, Zeiss, etc.



3D Scanning: Method Selection Guidelines

Method Selection Guidelines

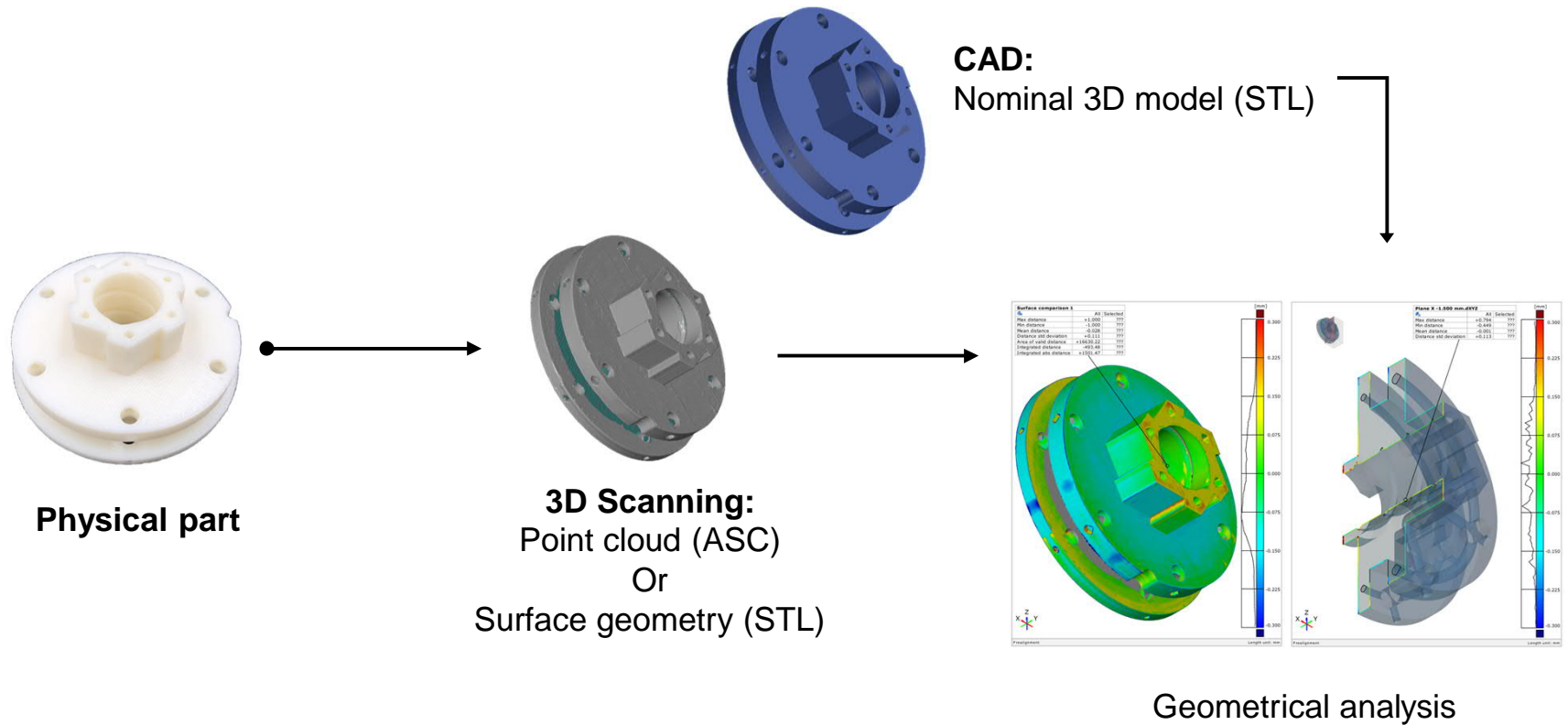
- **3D Scanning Technology**
 - Part size
 - Complexity
 - Material and surface
 - Traceability/accuracy
 - Interior or exterior
 - Speed
 - Availability

	Laser tracker	Direct Comparison	Tactile CMM	Optical CMM	X-ray tomography	Fringe projection	Fringe reflection / Deflectometry	Photogrammetry	Interferometry	Tactile Surface topography & Profilometry	Optical Surface topography & Profilometry	Confocal Microscopy	Scanning Force Microscopy
Part dimensions													
large	●	◐	●	●		◐		●	◐				
medium	●	◐	●	●		◐		●	◐				
small		●	●	●	●	●	●	●	●	◐	◐	◐	
micro			◐	◐	●	◐	◐		●	●	●	●	◐
Shape complexity													
low	●	●	●	●	●	●	●	●	●	●	●	●	●
medium	◐	◐	●	●	●	◐		◐		◐	◐	◐	◐
high	◐		◐	◐	●								
Material and surface													
hard, not sensitive	●	●	●	●	●	●	●	●	●	●	●	●	●
deformable	●	◐	◐	●	●	●	●	●	◐	◐	●	●	●
specular	●	●	●		●		●		●	●		◐	●
transparent	●	◐	●		●			●		●		◐	●
opaque	●	●	●	●	●	◐	◐	●	●	●	●	●	●
Traceability													
	◐	◐	●	◐	◐	◐	◐	◐	●	●	◐	◐	●

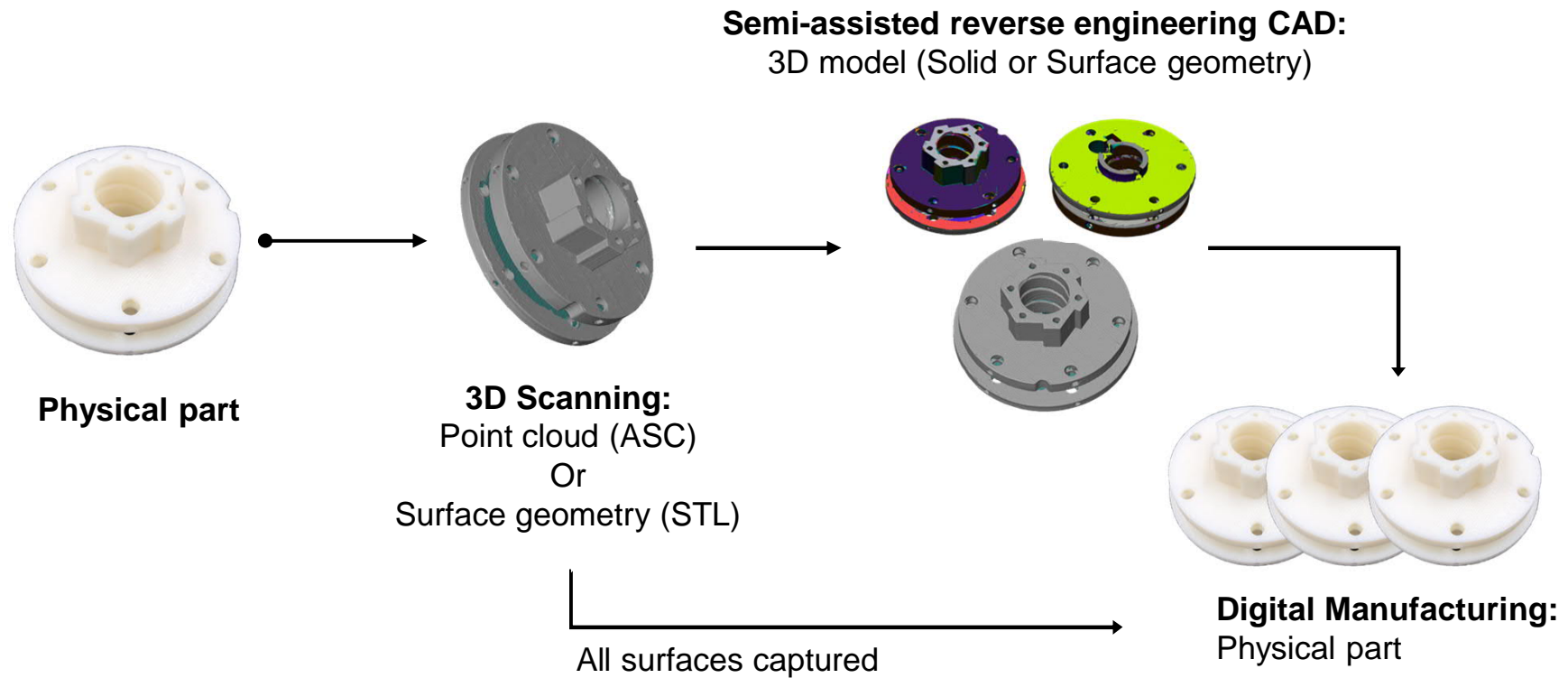
Legend:	full match:	●
	little match:	◐

3D Scanning: Application Workflows

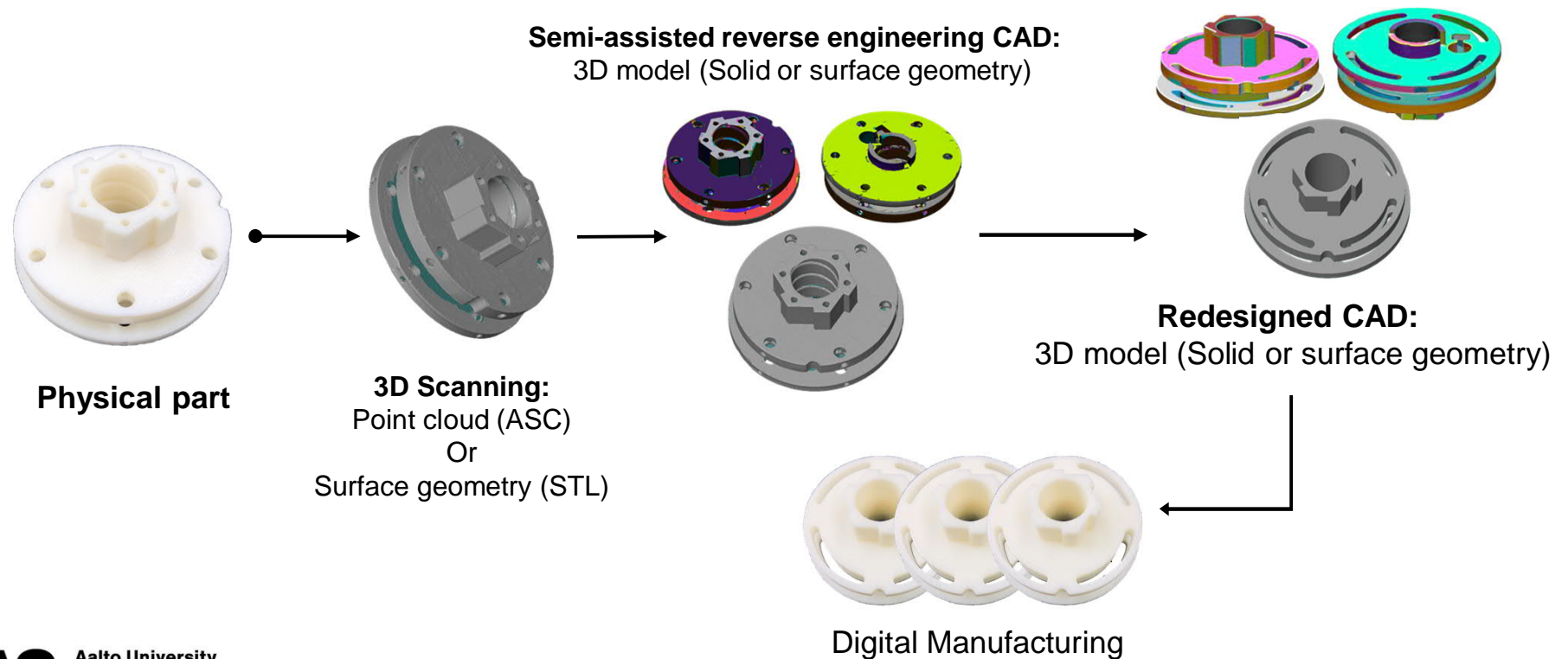
Workflow 1: Quality Control



Workflow 2: Reverse Engineering



Workflow 3: Reverse Engineering + Redesign



3D Scanning: Video

Confocal laser scanning microscopy



<https://www.youtube.com/watch?v=IJQNd8Ywc3U>

3D Scanning Demo

Thank you!

Q&A?

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