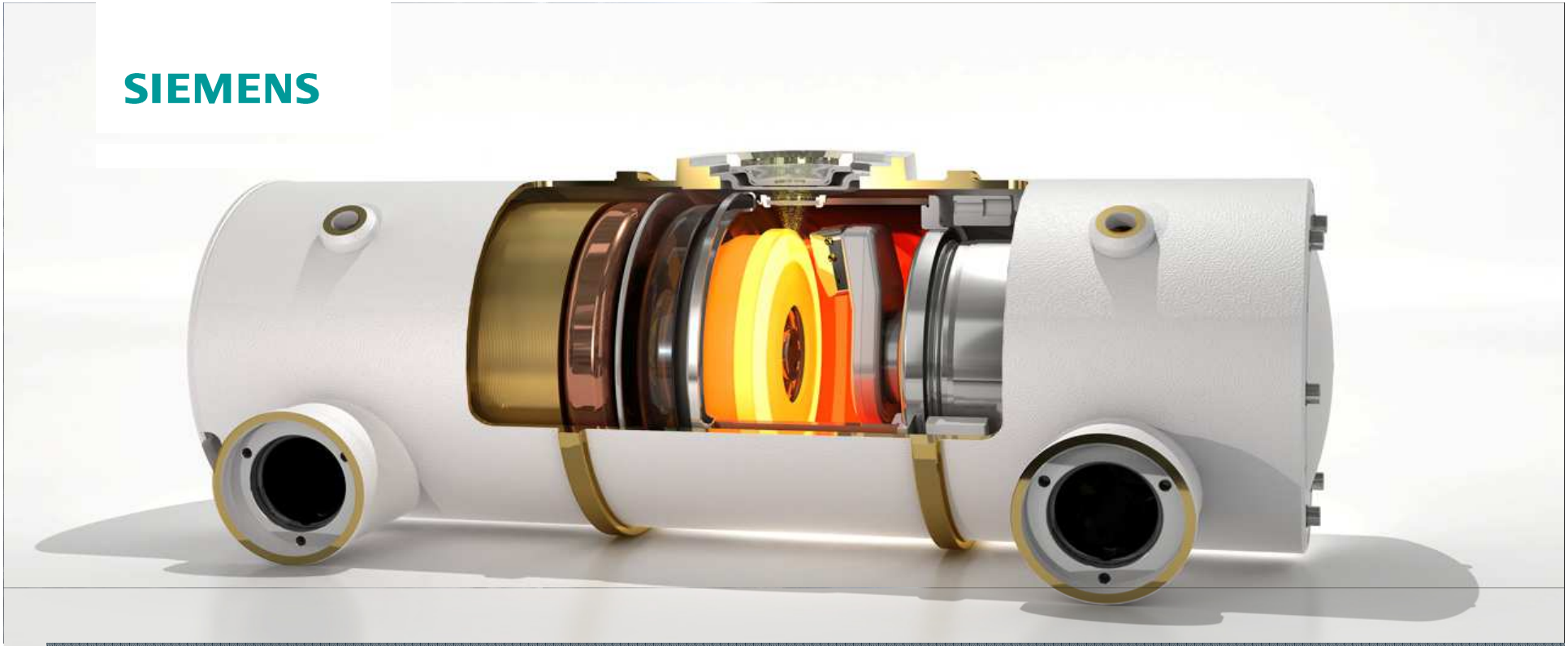
SIEMENS



Michael Schrapp, Jürgen Stephan, Matthias Goldammer, Karsten Schörner

Fast CT with High Power Tube and Low Number of Projections

Workshop on Industrial CT Scanning , TUM, München, 23-25 October 2013

Overview

1. Introduction
2. High power tubes
3. Reconstruction in computed tomography (CT)
4. CT Examples with few projections

Corporate Technology has a global presence to ensure proximity to internal clients

SIEMENS

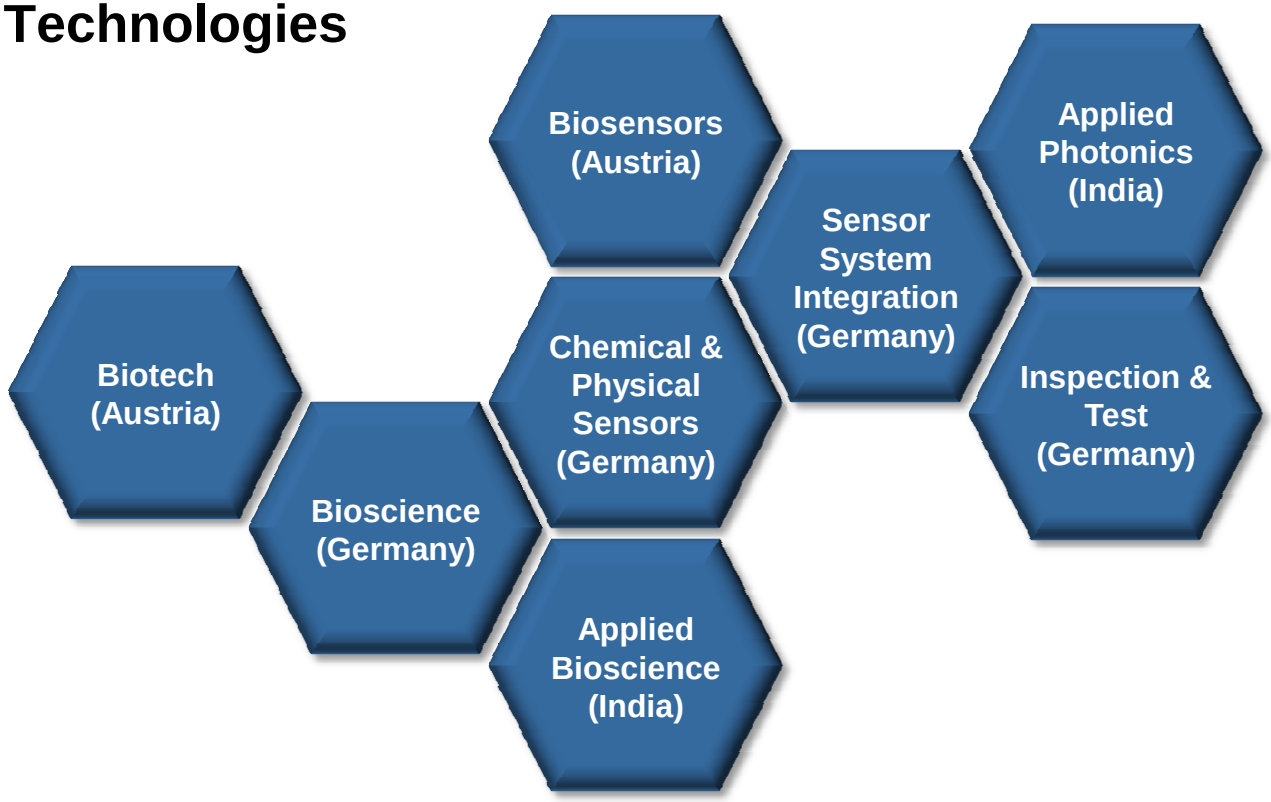
Global organization of CT (major locations)

Siemens Corporate Technology

SIEMENS

Corporate Technology Research & Technology Center
Sensor Technologies

Sensor Technologies



CT RTC SET
Dr. Thomas Scheiter

Email Thomas.Scheiter@siemens.com
Phone +49 89 636-45588
Fax +49 89 636-48555
Intranet https://intranet.w1.siemens.com/cms/ct/en/main/rtc/set/Pages/Default.aspx

Mission

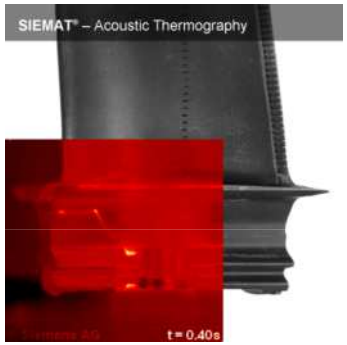
Interfacing the world

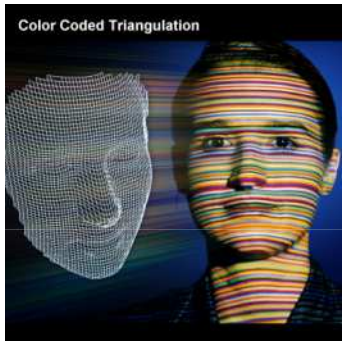
Siemens Corporate Technology

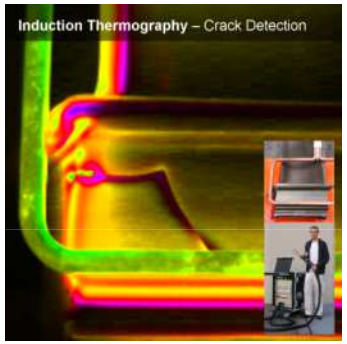
SIEMENS

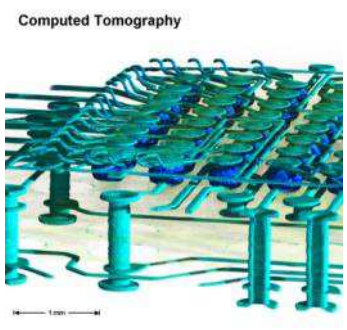
Corporate Technology Research & Technology Center
Sensor Technologies

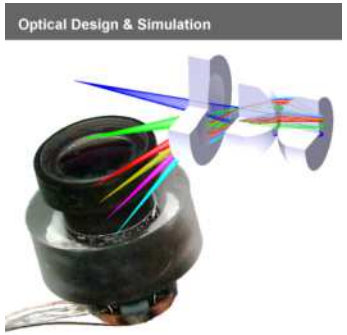
Inspection & Test (Germany)

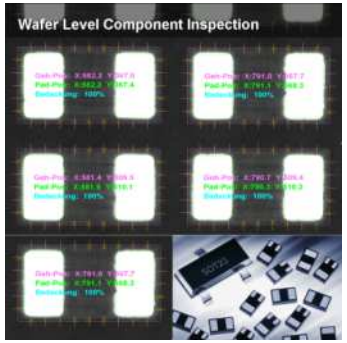


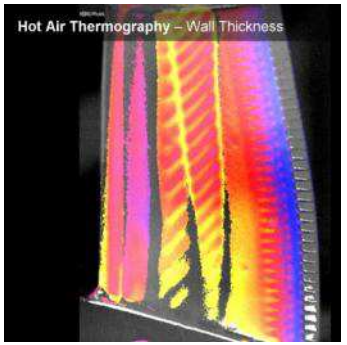


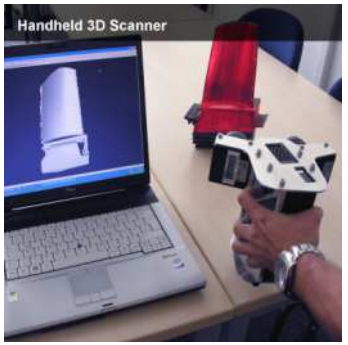












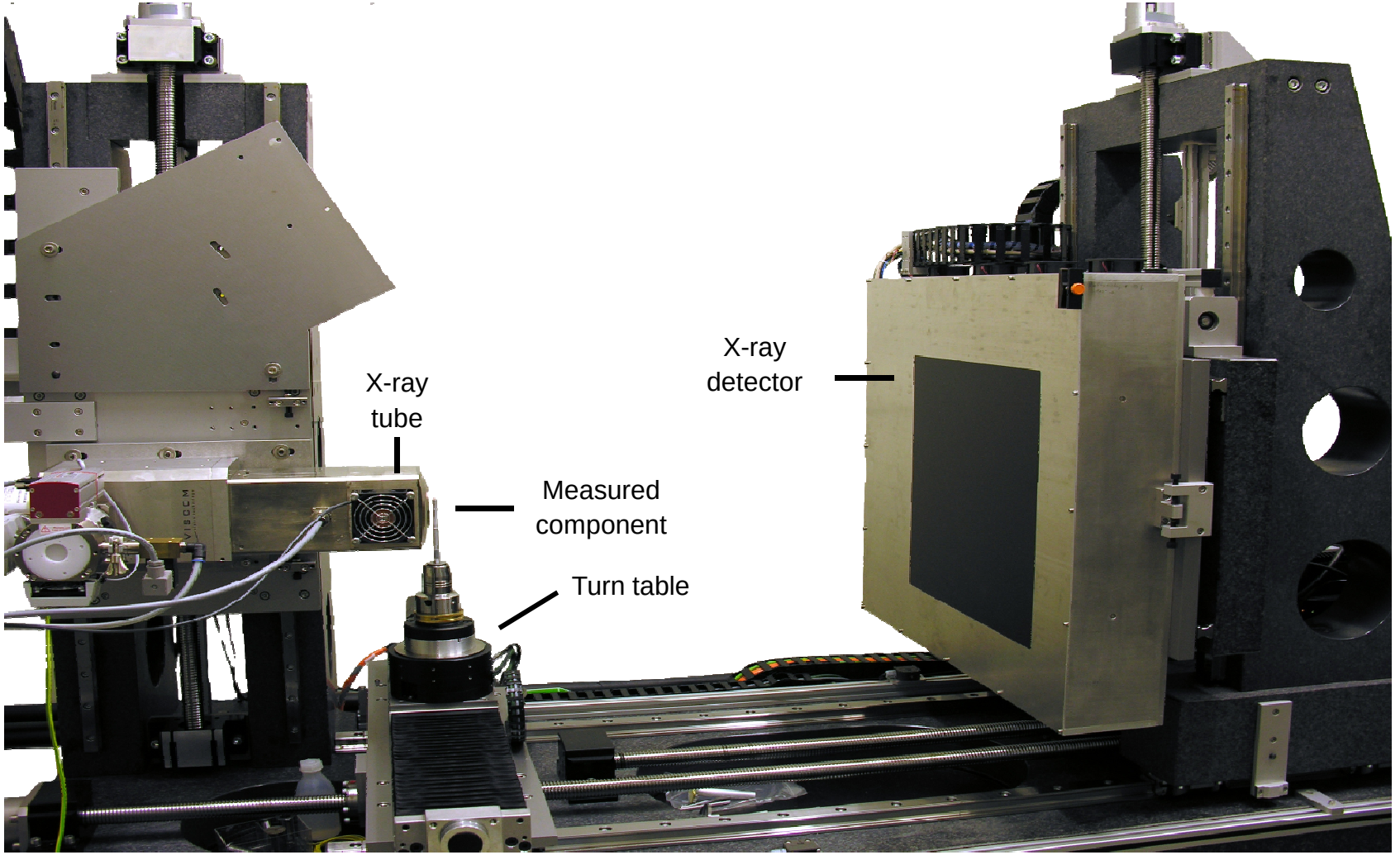
CT RTC SET INT-DE
Dr. Claudio Laloni

Email Claudio.Laloni@siemens.com
Phone +49 89 636-49901
Fax +49 89 636-46192
Intranet http://www.siemens.com/innovation/de/

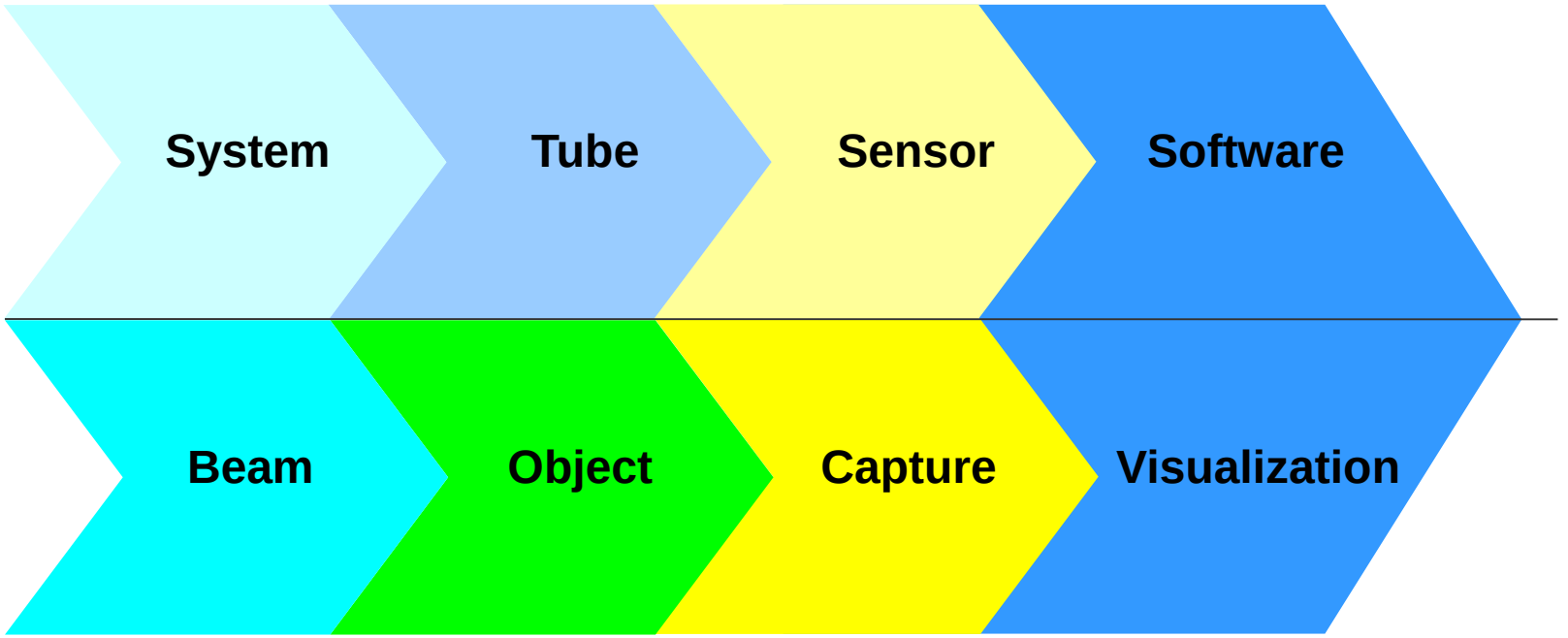
Mission

Industrial state-of-the-art inspection solutions

Typical Setup for Industrial CT- Scanner

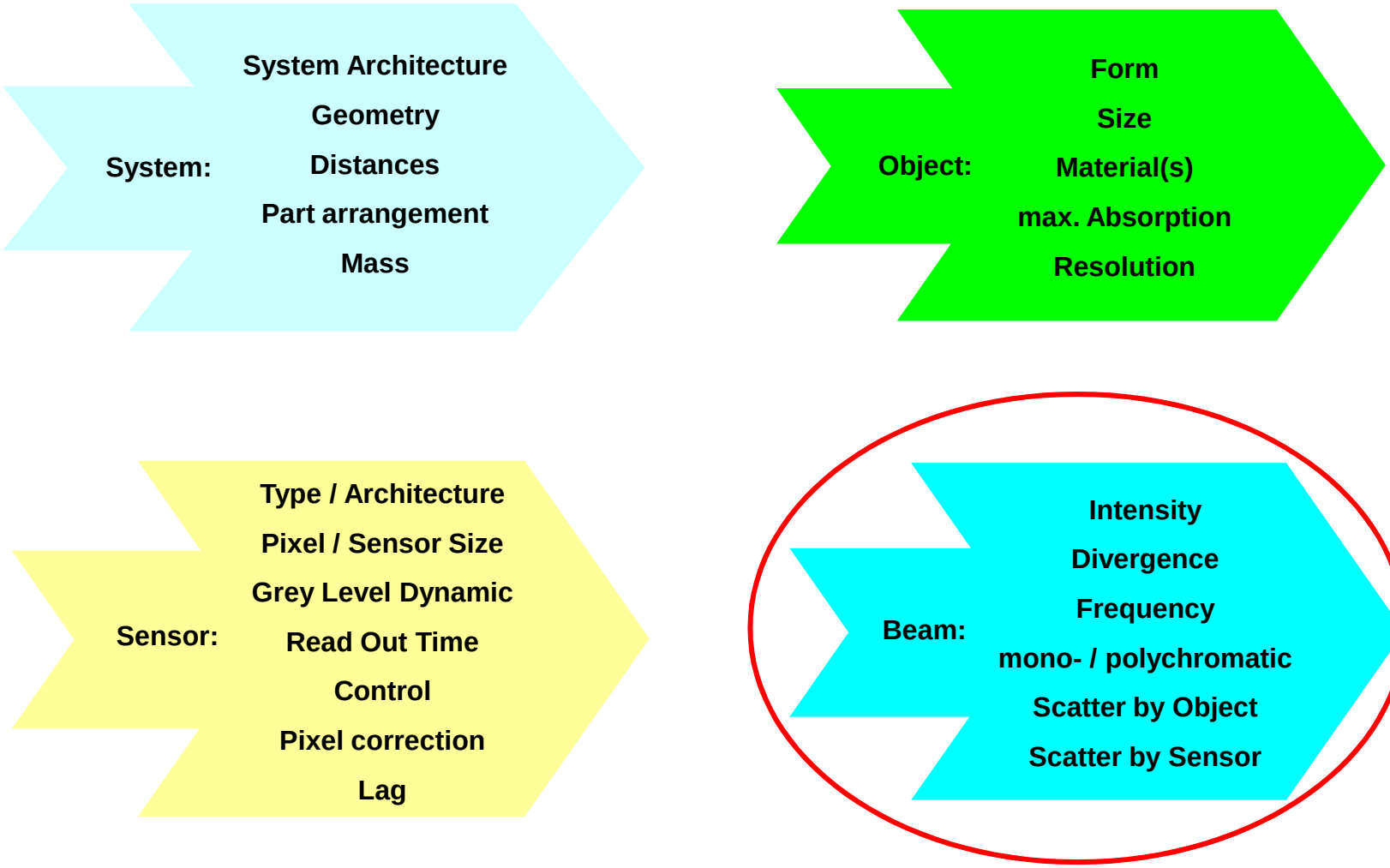


Influencing Factors to 3D X-ray Tomography

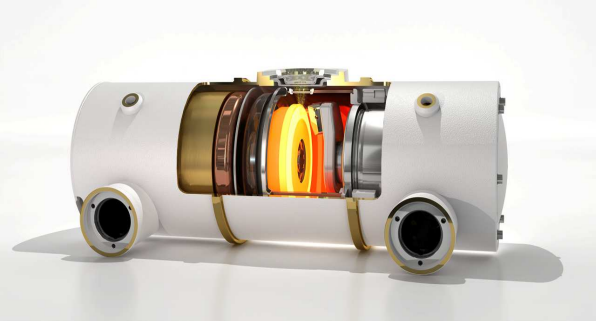


VDI/VDE Richtlinien 2630 Blatt 2: Computed tomography in dimensional measurement – Influencing variables on measurement results and recommendations for computed tomography dimensional measurements

Influencing Factors to 3D X-ray Tomography



New: High Power Tube Megalix



Max. Power (pulsed): 86 kW
(pulse width 100 ms/s, cycletime 74 s)

Continuous Power 2500 W (>30 min)

Max. Voltage 120 kV

More Stability ➔ Advanced medicine technology

Higher Dose ➔ Better Signal to Noise Ratio important for scatter analysis and large parts

Shorter measurements Fast tomography

Pulsed beam ➔ CT without stop and go of turn axis

Actual focus size with our tube 0.4 / 0.8 mm² ~ 4 kW cooling necessary

CERA: Siemens CT Reconstruction Software

CERA module overview

CERA-BASIC
Fast and high-quality CT reconstruction using filtered backprojection

CERA-CMP*
Efficient correction of geometry misalignments

CERA-ITR*
High-performance, iterative algorithms for flexible CT reconstruction

CERA-TXR*
Exact CT reconstruction for high image quality without cone-beam artifacts

CERA-RED*
Advanced artifact and noise reduction for better image quality

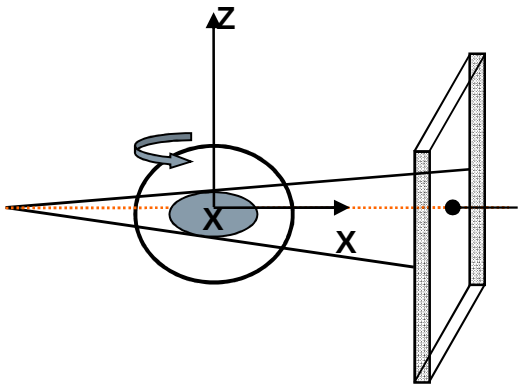
CERA-VRT
Fast and high-quality 3D volume visualization with high resolution

Calibration *Reconstruction* *Visualization*

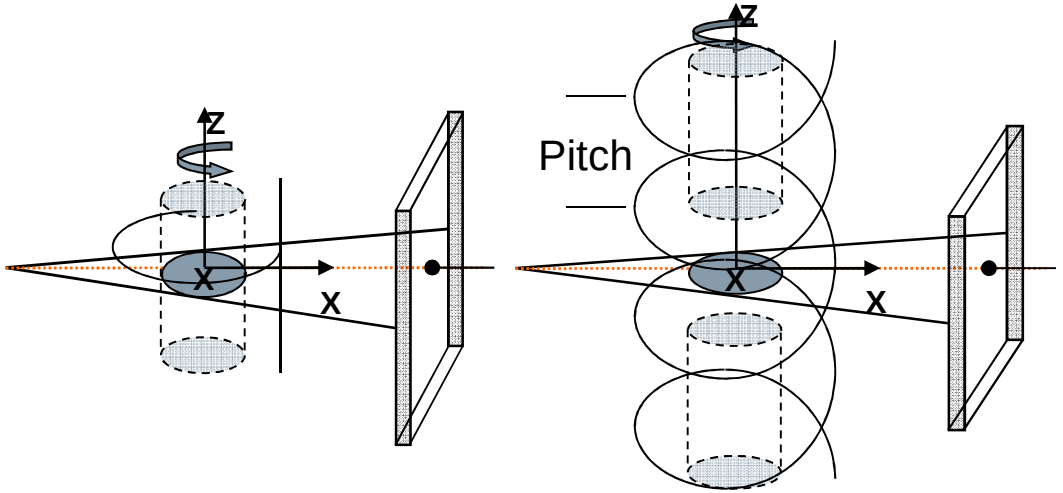
*add-on module for CERA-BASIC TXR includes efficient Helix reconstruction

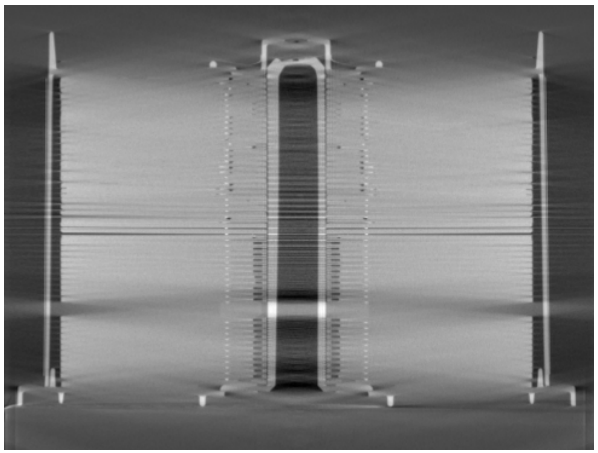
Example of CERA TXR Reconstruction

FDK full circle trajectory



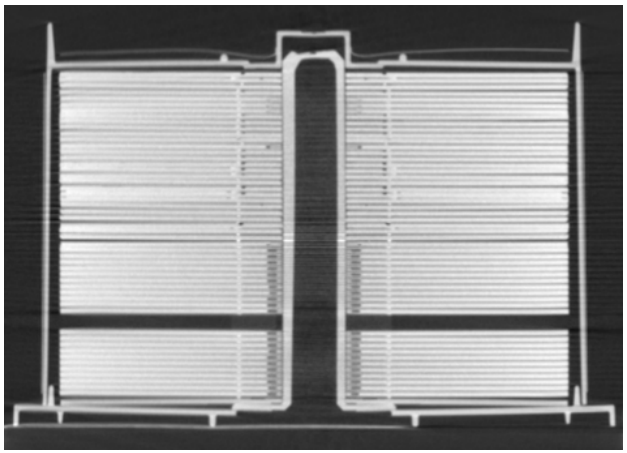
TXR or Helix trajectory





FDK Reconstruction

TXR Circle+Line Reconstruction



Reconstruction Methods in CT

SIEMENS

Filtered Backprojection (FBP)

→ Standard reconstruction technique (fast)

→ Inadequate treatment of missing and incorrect data

better:

Iterative Algorithms

→ Algebraic reconstruction (ART, SIRT,SART)

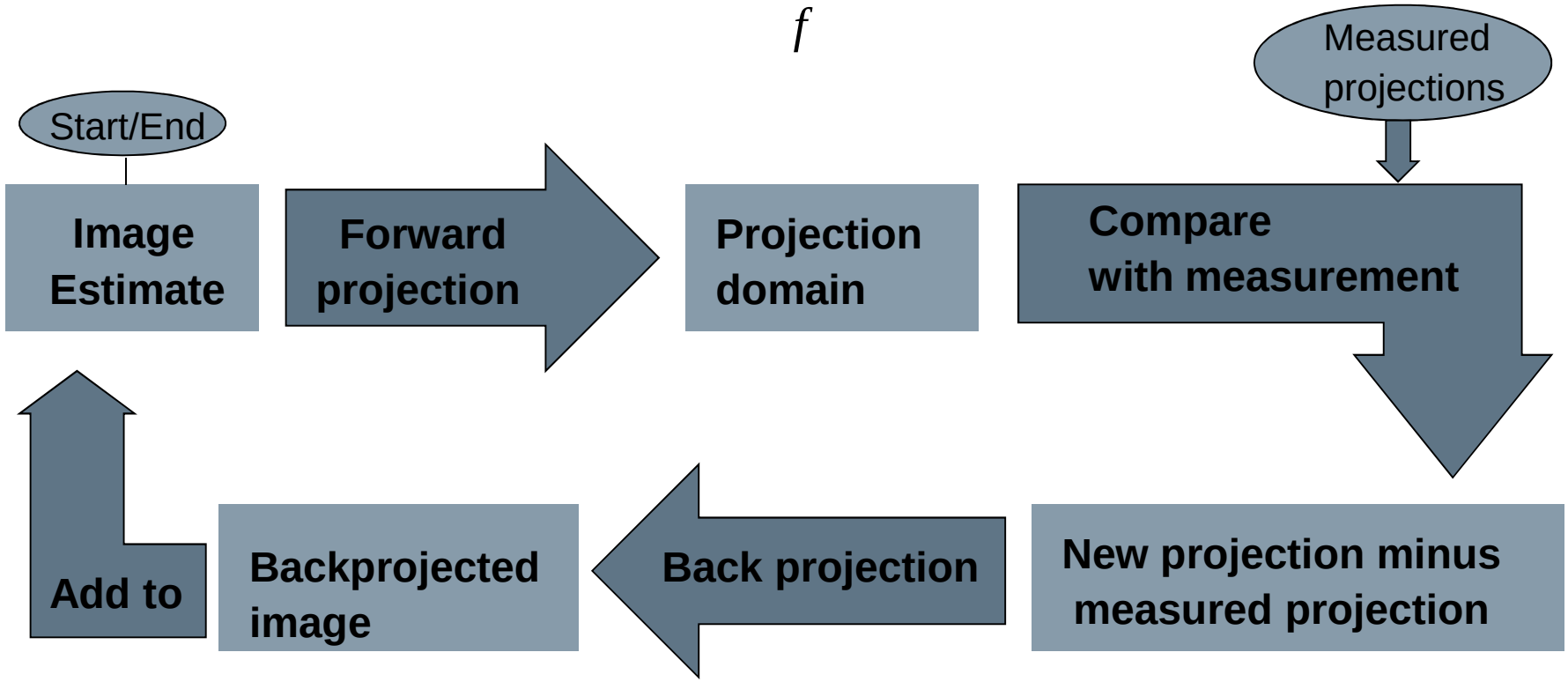
→ Statistical methods (Maximum Likelihood, OSEM)

→ Arbitrarily acquisition geometries, few projections

→ Easy to incorporate a priori knowledge

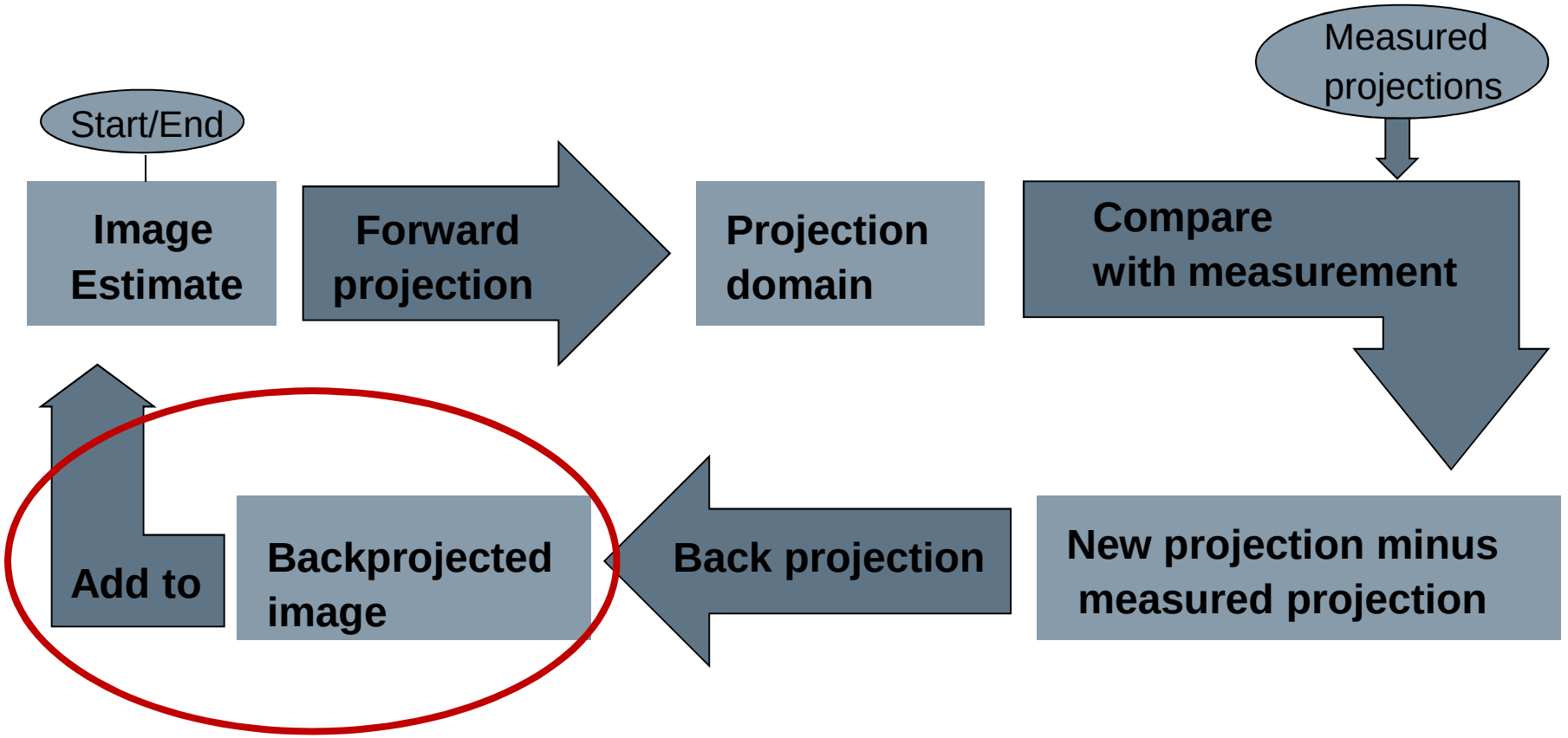
Simultaneous Algebraic Reconstruction Technique

Graphical visualization to solve $\arg\min_f \| Af - p \|$



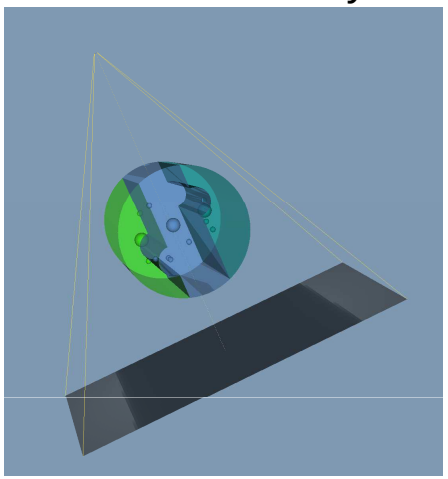
Limited Number of Projections

Compressed sensing (Total Variation)



Application 1: Liquid Flow Measurement

Simulation Study:

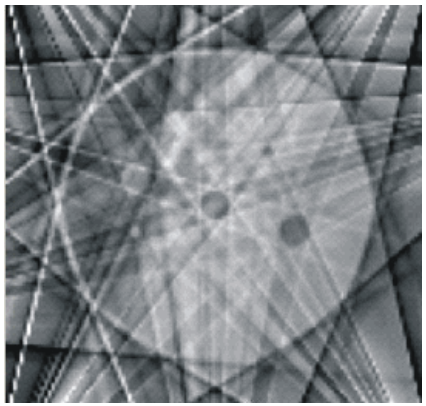


Pipe filled with oil, water and gas with bubbles

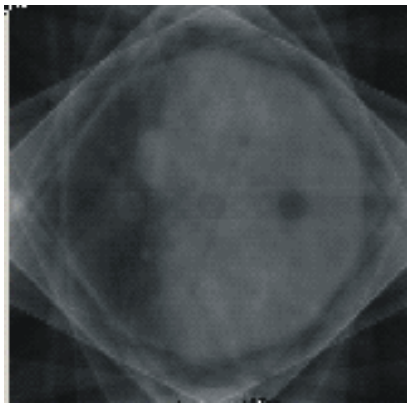
Beam polychromatic (120 kV)
2“ pipe diameter
Pixel size 1 mm
Detector no of pixels 120 x 64
FDD 115 mm
FOD 65 mm

40 Projections (TV-SART)

10 Projections (SART)



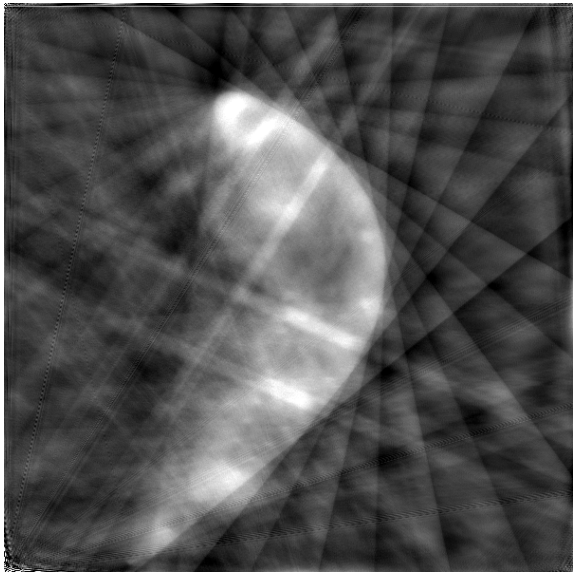
10 Projections (TV-SART)



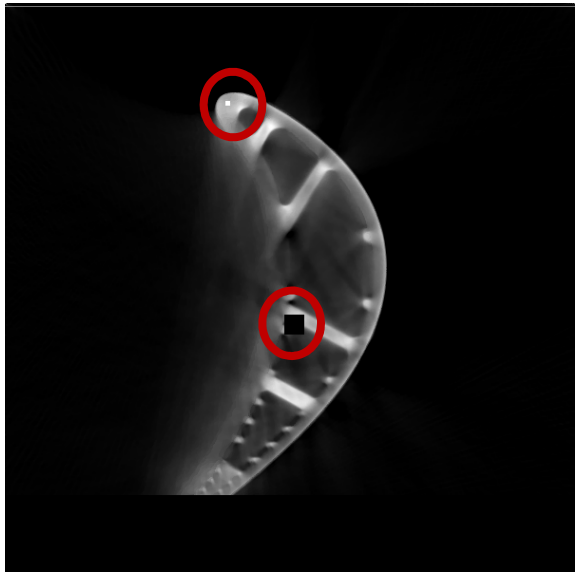
Application 2: Turbine Blades

Few view reconstruction with prior data

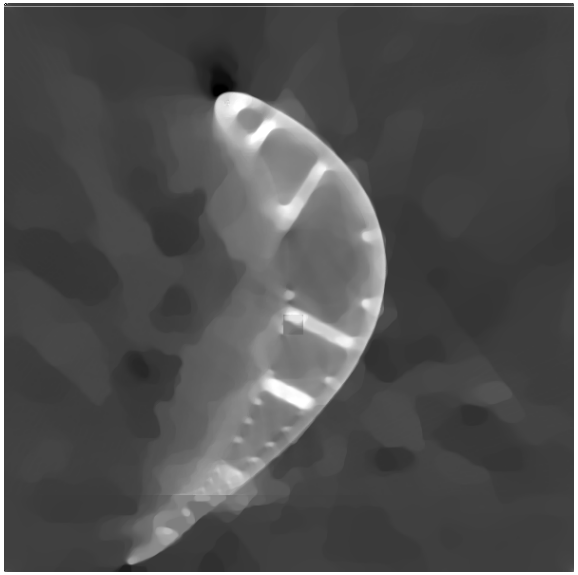
15 equidistant projections



Prior data image



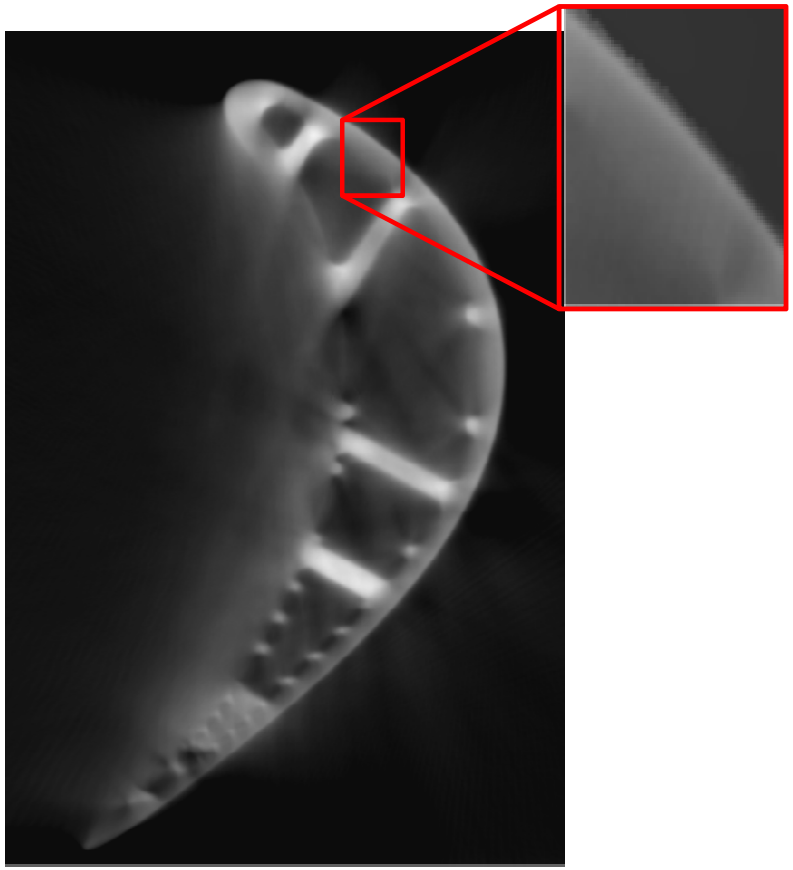
Final reconstruction, 15 projections



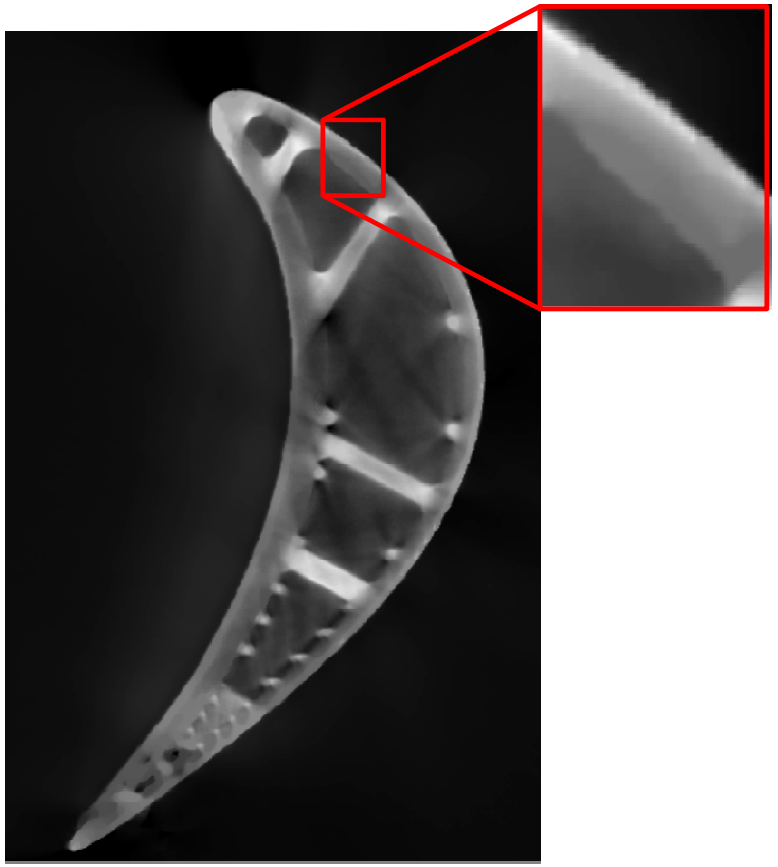
Application 3: Turbine blades with sufficient number of projections – Data Fusion

SIEMENS

Standard reconstruction



With surface and ultrasonic data



Thank You! Any Questions?

Michael Schrapp
Ph.D. Student
Corporate Technology
RTC SET INT-DE

Otto-Hahn-Ring 6
81739 Munich

Tel: +49 89 636-34258

Fax: +49 89 636-46192

E-mail:
michael.schrapp@siemens.com

siemens.com/answers