

Topology analysis of polymer tube sections using μ CT images

Image Guided Therapy Lab 2019

Author: Reto Furrer

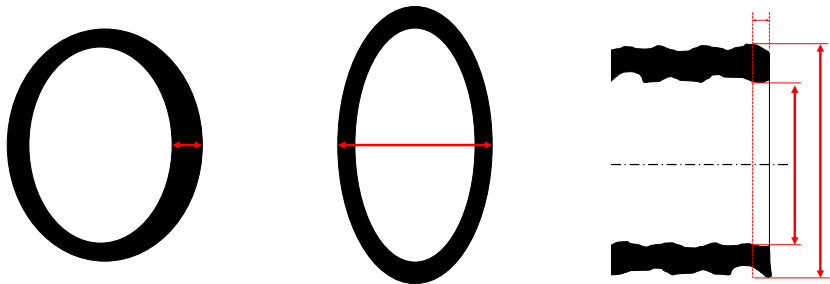
Supervisor: Adrian Zurbuchen, PhD

Master in Biomedical Engineering, University of Bern

September 12, 2019

Introduction

What are limitations of current measurement methods?

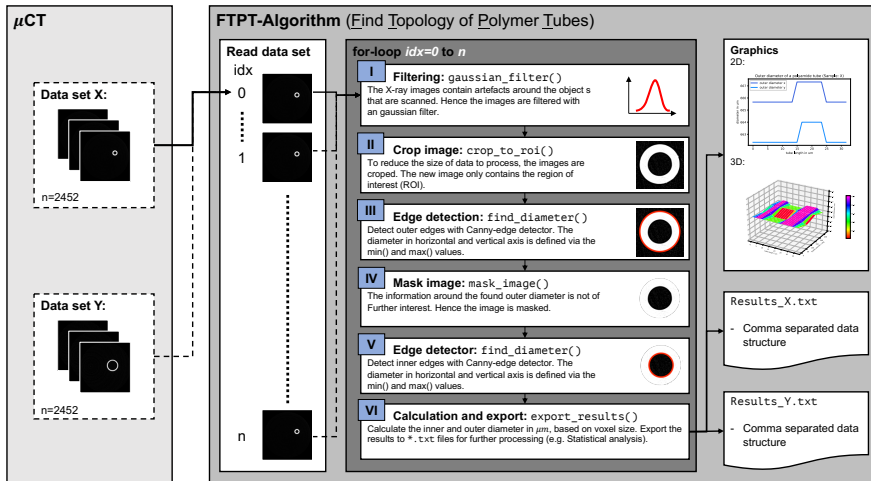


Hypothesis

The shaft topology of a percutaneous transluminal coronary angioplasty catheter can be quantified accurately by using micro-computed tomography images.

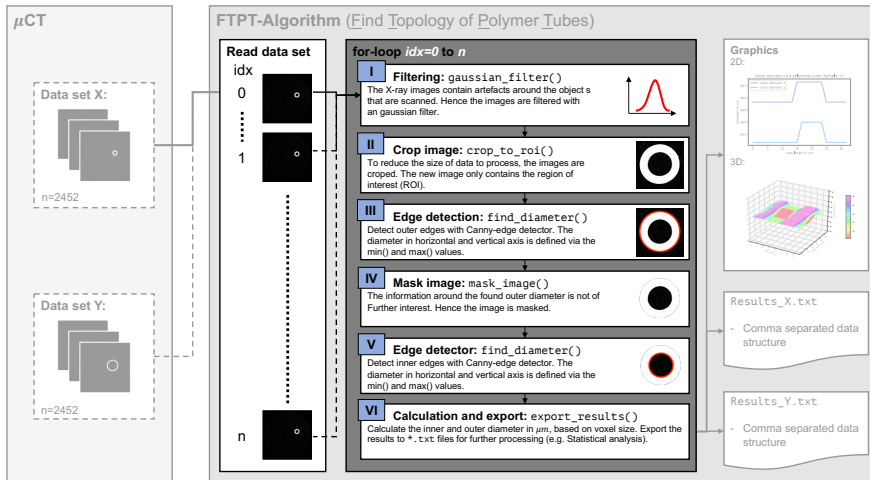
Material and Methods

Image processing algorithm



Material and Methods

Image processing algorithm



Material and Methods

The following variables were evaluated:

1. **Homogeneity of the topology** is the differences of the diameters on two perpendicular axes.
2. **Deviation from tube specifications.** The specification limits of the inner- and outer diameter.
3. **Topology differences between plain and necked tubes.**
Comparison of the two tube samples.

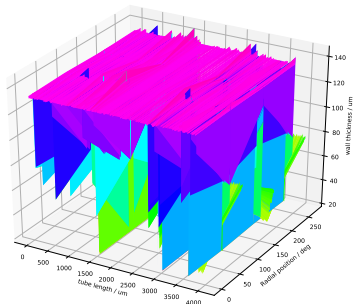
Statistical analysis

The Wilcoxon-sign rank test was applied to analyse the differences. All analyses were performed using the software R, and significance levels were set at $p = 0.05$.

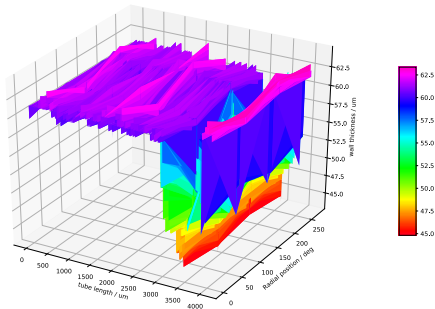
Results

1) Homogeneity of the topology

Plain tubes



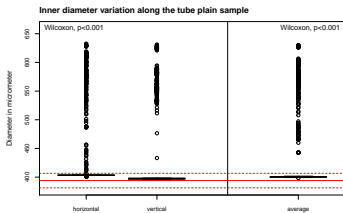
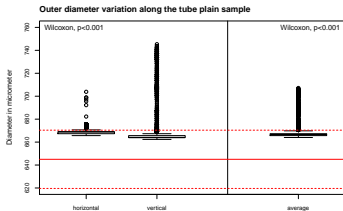
Necked tubes



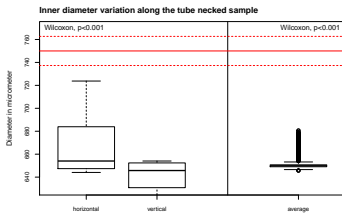
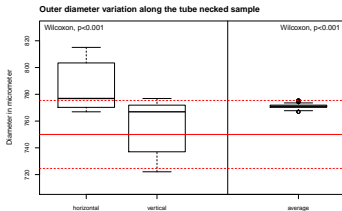
Results

2) Deviation from tube specifications

Plain tubes

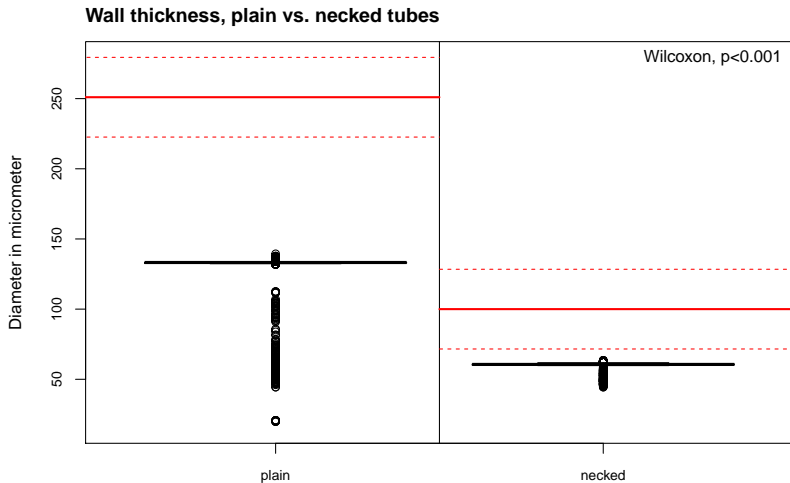


Necked tubes



Results

3) Topology differences between plain and necked tubes



Discussion

- > Algorithm to **analyse the topology** of polymer tubes was presented.
- > In an **empiric study** the differences of diameters in **various directions were measured**.
- > **Statistical significant** differences ($p < 0.001$) were shown for:
 1. Homogeneity of the topology
 2. Deviation from tube specifications
 3. Topology between plain and necked tubes
- > We conclude that the **presented algorithm** is able to **evaluate the topology** of PTCA catheter tubes.

Thank you!

You can find the documentation on GitHub

https://github.com/refurrer/IGTLab_RetoFurrer_2019

Summary

Background:

- > The catheter shaft topology is important for the rated burst pressure (RBP).
- > The topology must be quantified to control and optimise the RBP.

Material and Methods:

- > An image processing algorithm is proposed to evaluate:
 - (1) The homogeneity of the tube topology,
 - (2) Deviations from the specifications,
 - (3) Differences between plain and necked tubes.

Results:

- > The evaluation showed statistically significant differences in all tests.

Discussion:

- > The presented algorithm is able to evaluate the topology of catheter tubes.