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Topology analysis of polymer tube sections using μCT images

Image Guided Therapy Lab 2019

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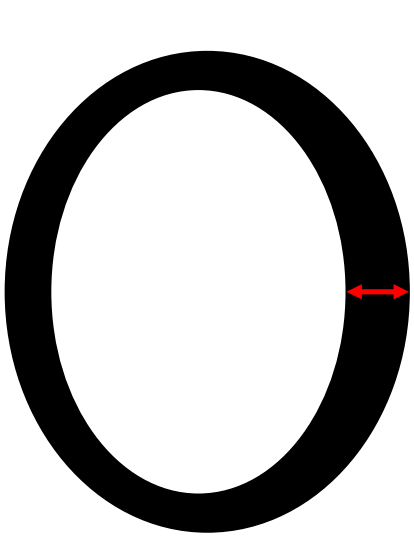
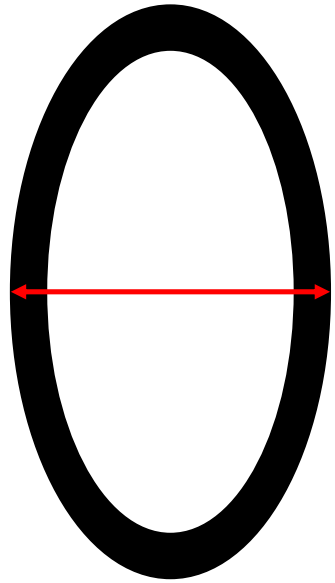
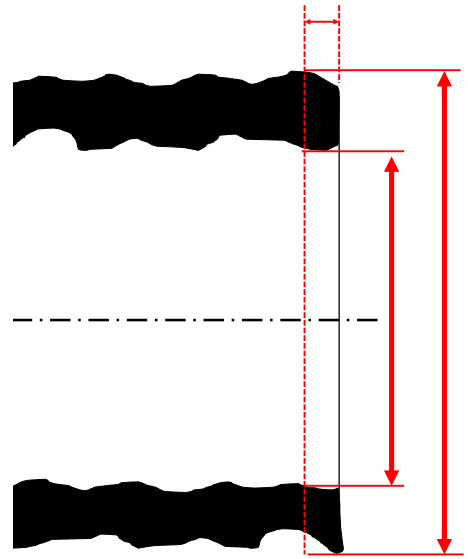
September 12, 2019

Introduction

What are limitations of current measurement methods?





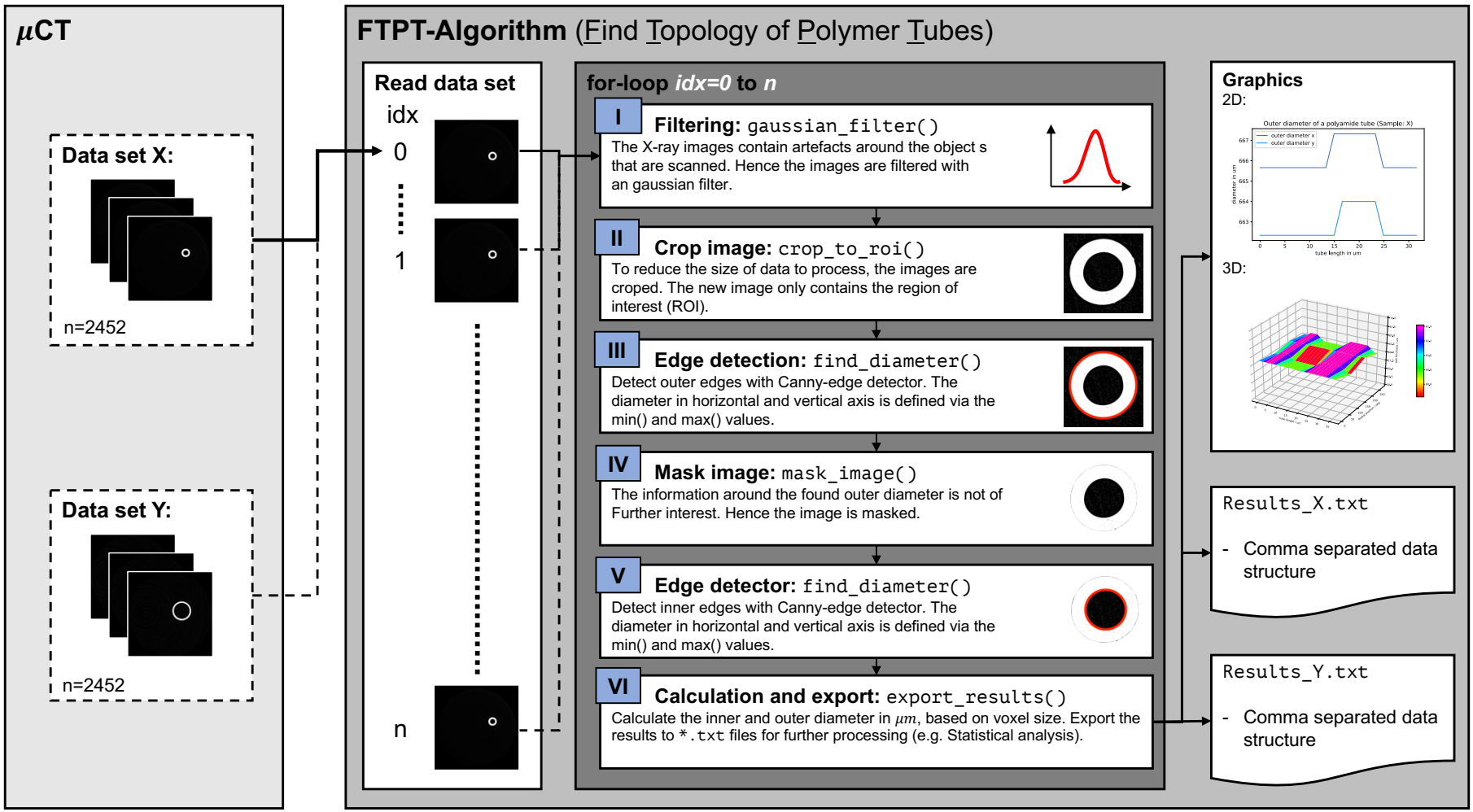


Hypothesis

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

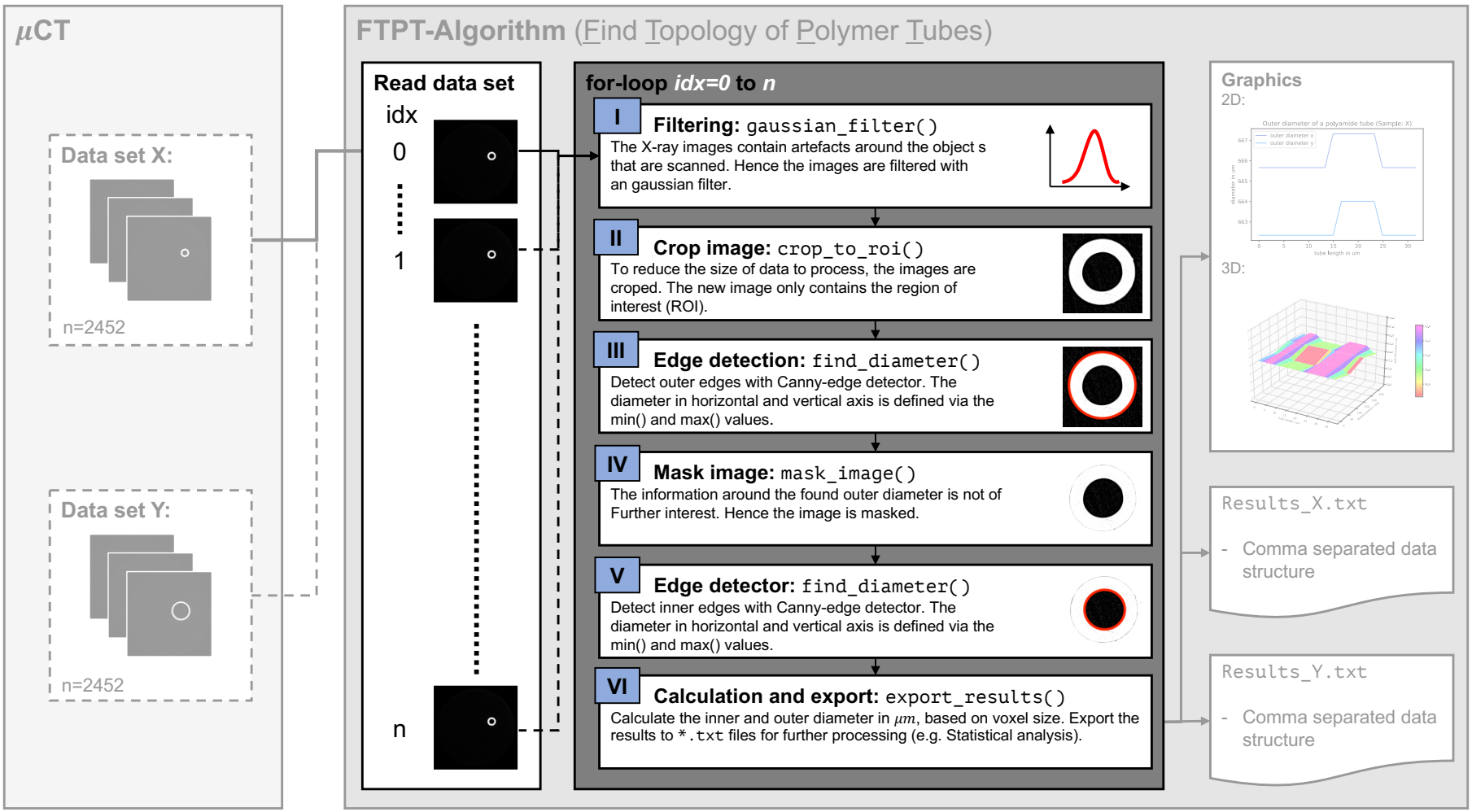
Material and Methods

Image processing algorithm



Material and Methods

Image processing algorithm



Material and Methods

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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.

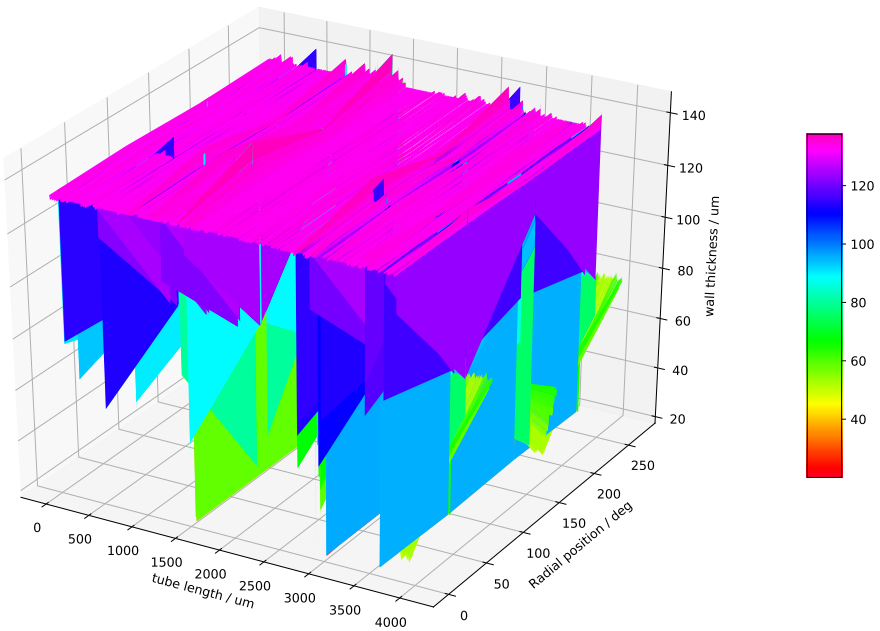
Statistical analysis

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 $p = 0.05$.

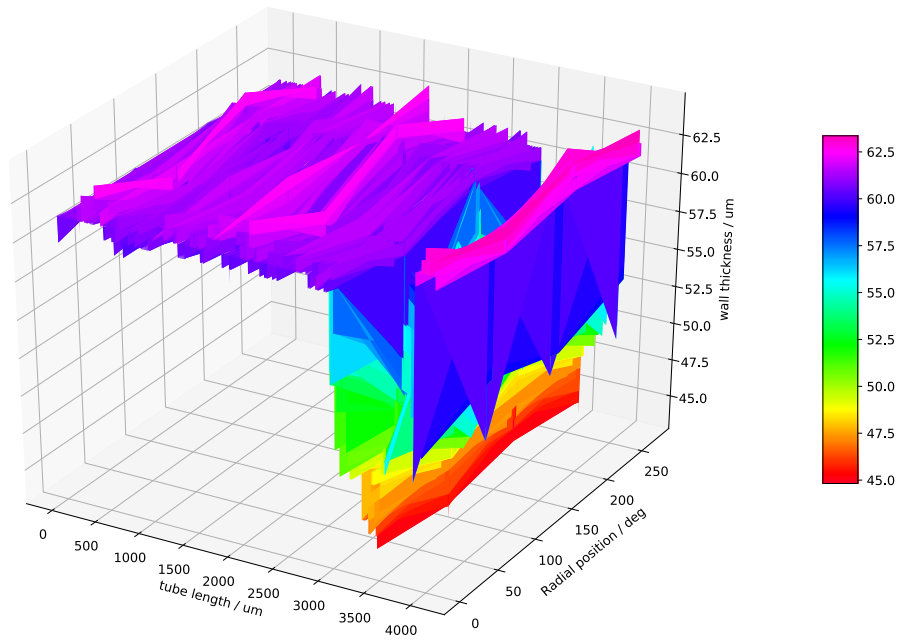
Results

1) Homogeneity of the topology

Plain tubes



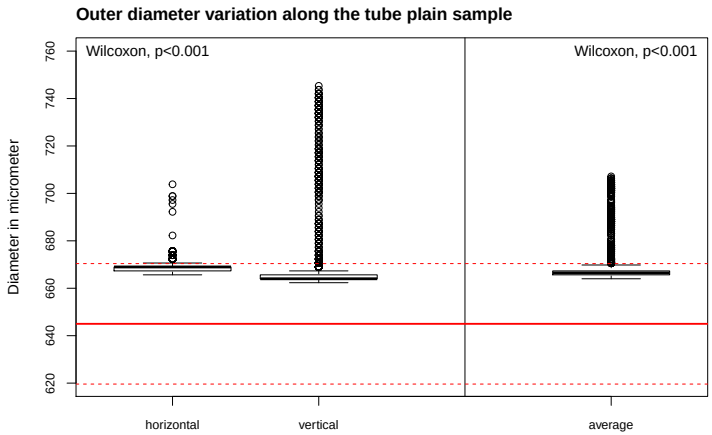
Necked tubes

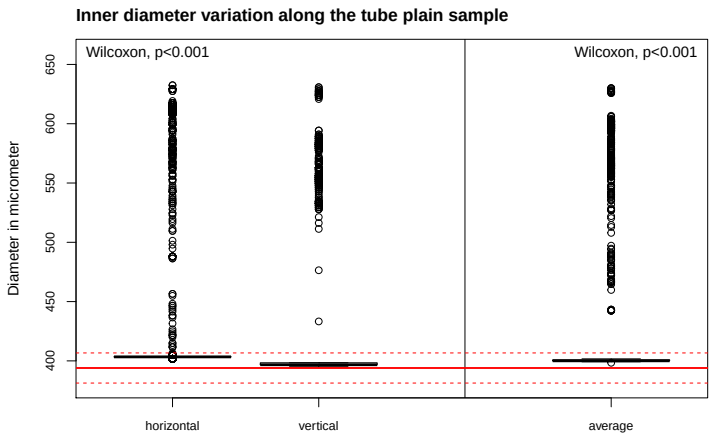


Results

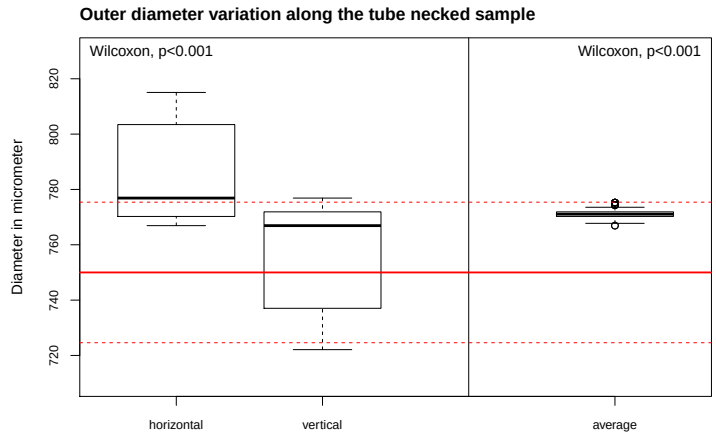
2) Deviation from tube specifications

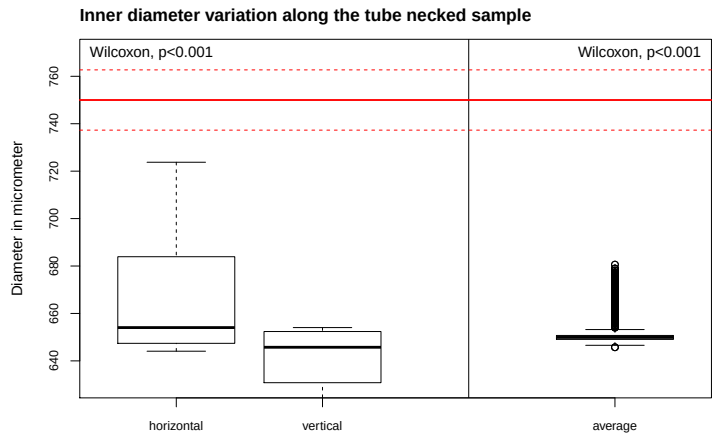
Plain tubes





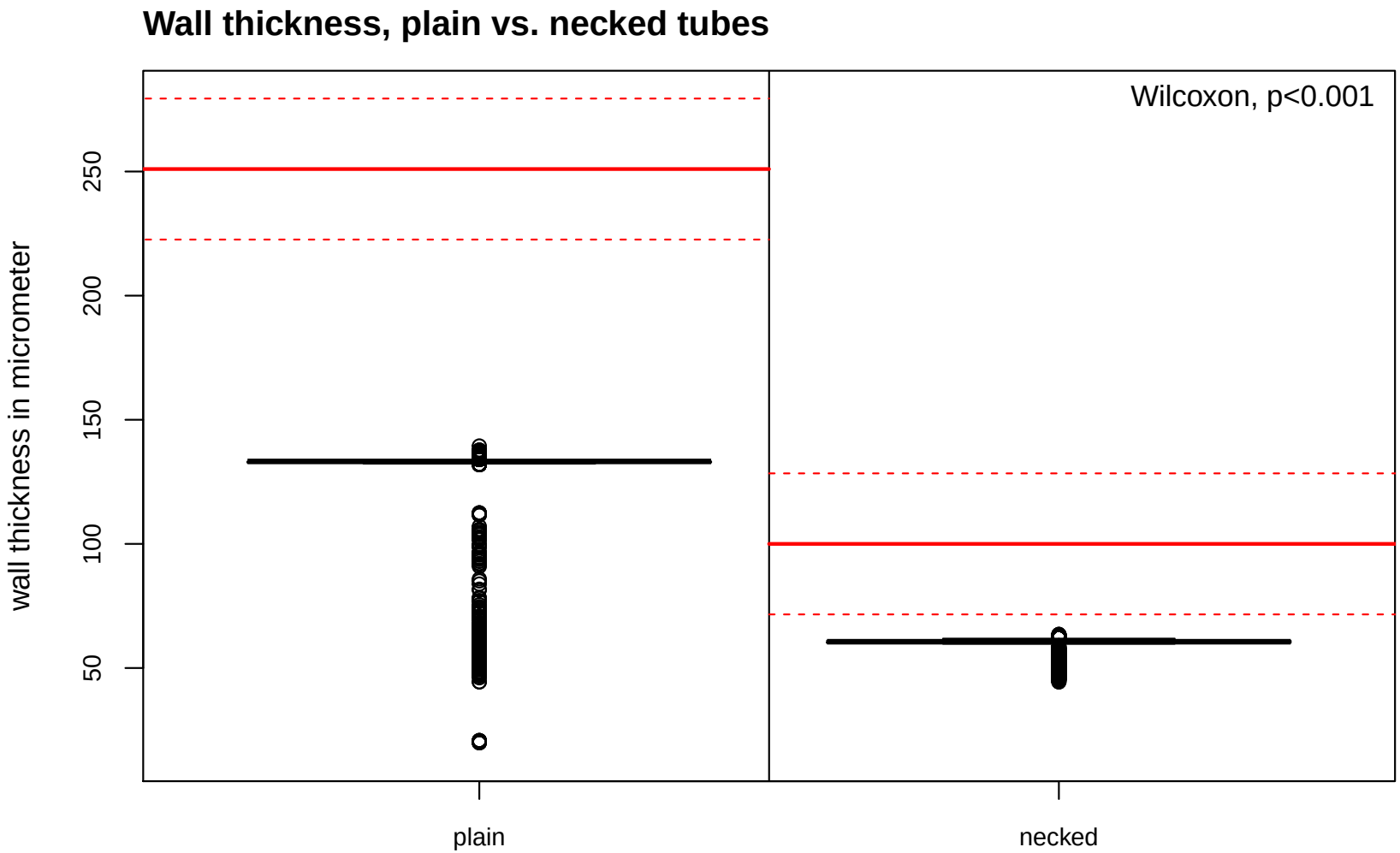
Necked tubes





Results

3) Topology differences between plain and necked tubes



Discussion

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- 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

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Background:

- The catheter shaft topology is important for the rated burst pressure (RBP) of coronary catheters.
- 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.