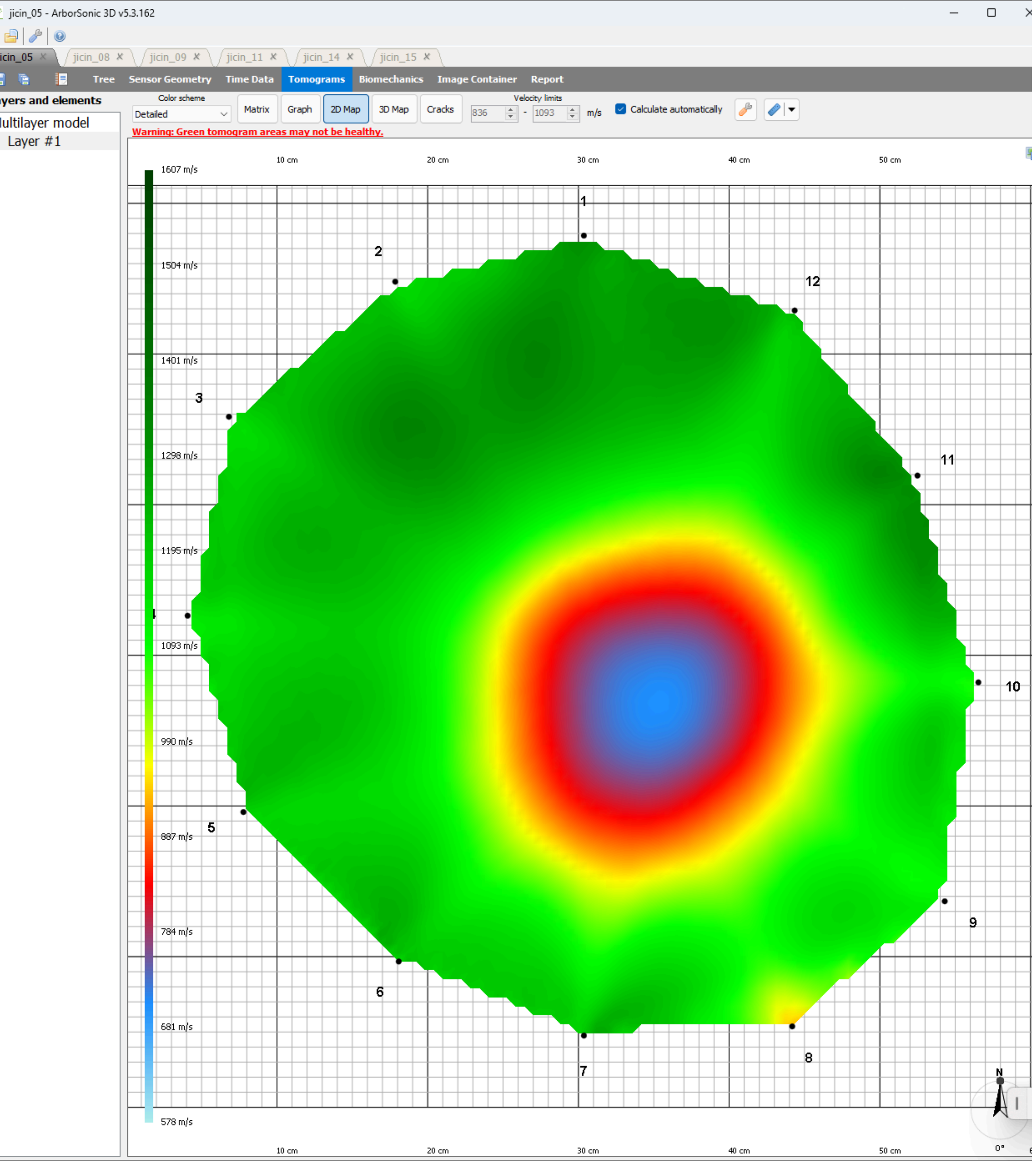
Resistograph meets tomograph

Robert Mařík & Valentino Cristini

Mendel University in Brno

Content of the talk

- Resistograph and tomograph: strengths and limitations
- Combined approach: a Python library to merge data from both devices
- Technical note 1: vibe coding in 2025 (GUI via ChatGPT)
- Technical note 2: code sharing in 2025 (Docker)



jicin_05 - ArborSonic 3D v5.3.162

icin_05 | jicin_08 | jicin_09 | jicin_11 | jicin_14 | jicin_15

Tree | Sensor Geometry | Time Data | Tomograms | Biomechanics | Image Container | Report

yers and elements

ultilayer model

Layer #1

Color scheme: Detailed

Matrix | Graph | 2D Map | 3D Map | Cracks

Velocity limits: 836 - 1093 m/s

☑ Calculate automatically

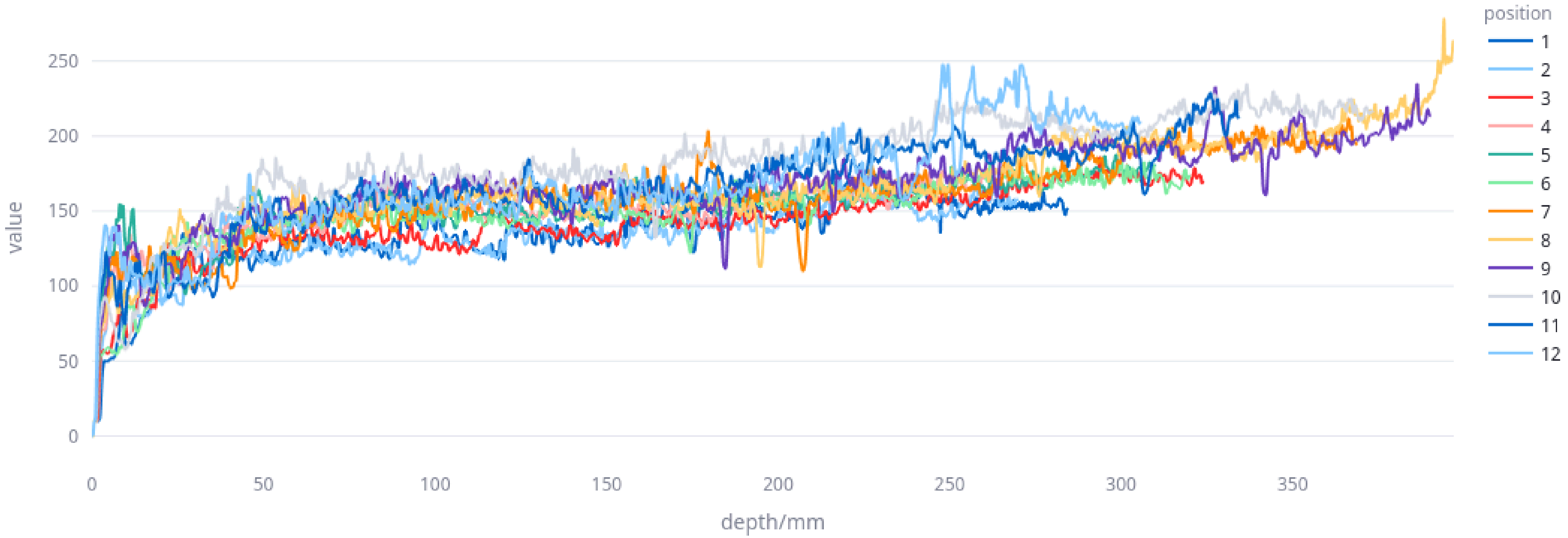
Warning: Green tomogram areas may not be healthy.

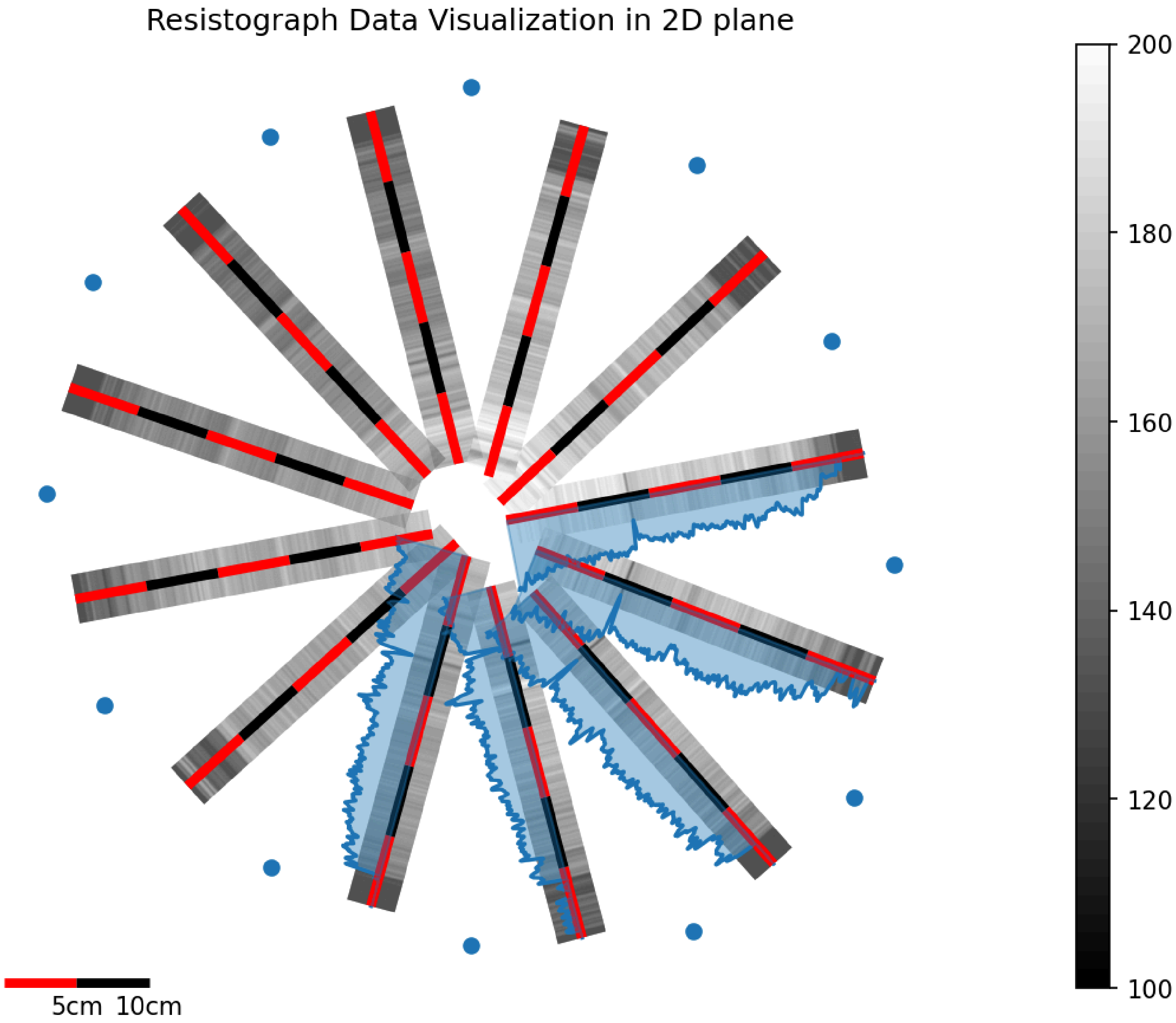
Tomograph

- fast and reliable tool for stem inspection
- global information from the whole cross section
- shows the size and shape of the internal defects
- cracks are reported as cavities

Resistograph

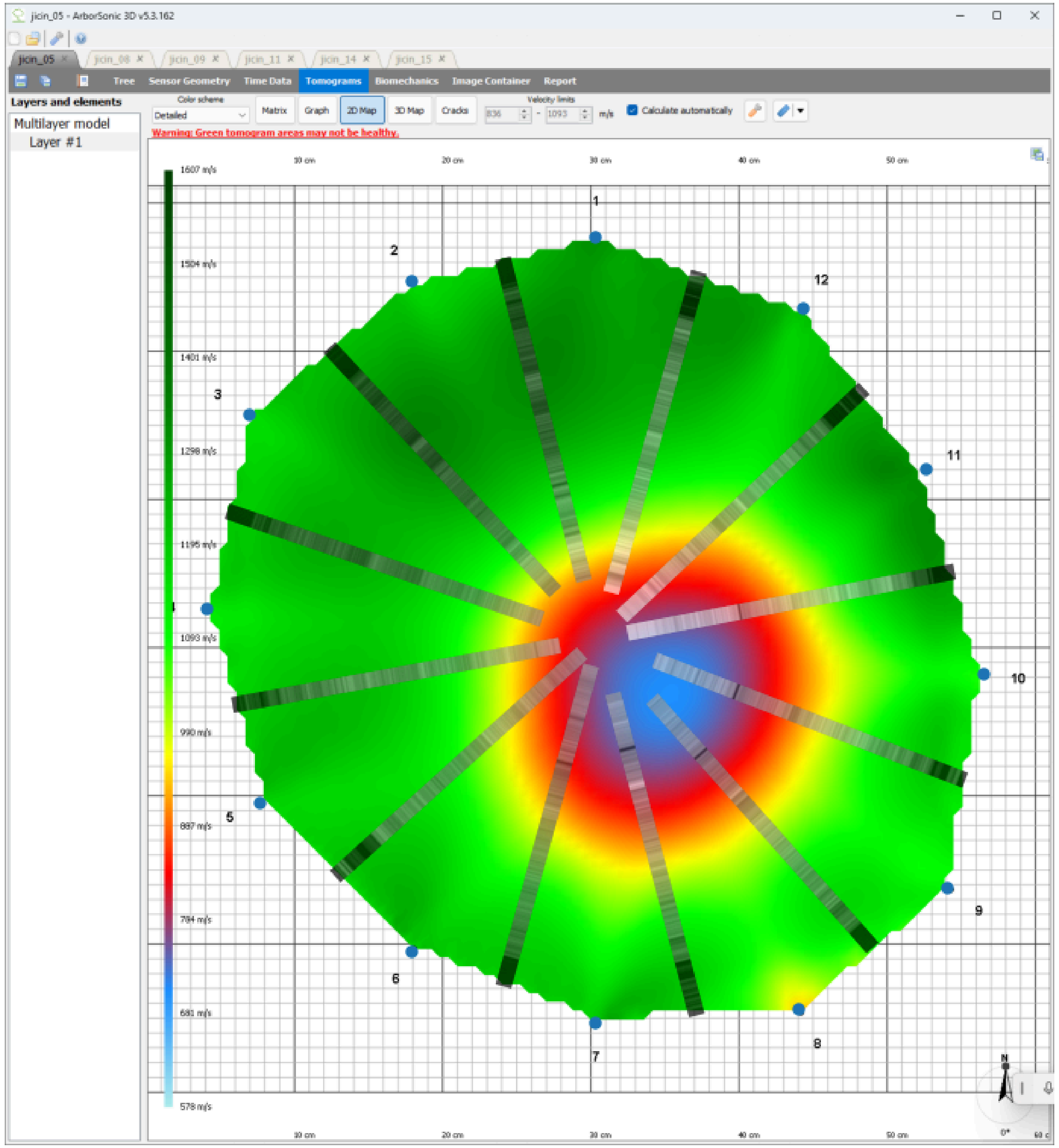
- scans the power required to microdrilling at given speed
- measures mechanical properties of the material
- local information





Merge data I

- Transform resistograph data to 2D geometry of the cross section
- Visualize the data in the new geometry



jicin_05 - ArborSonic 3D v5.3.162

Layers and elements

Multilayer model

Layer #1

Color scheme: Detailed

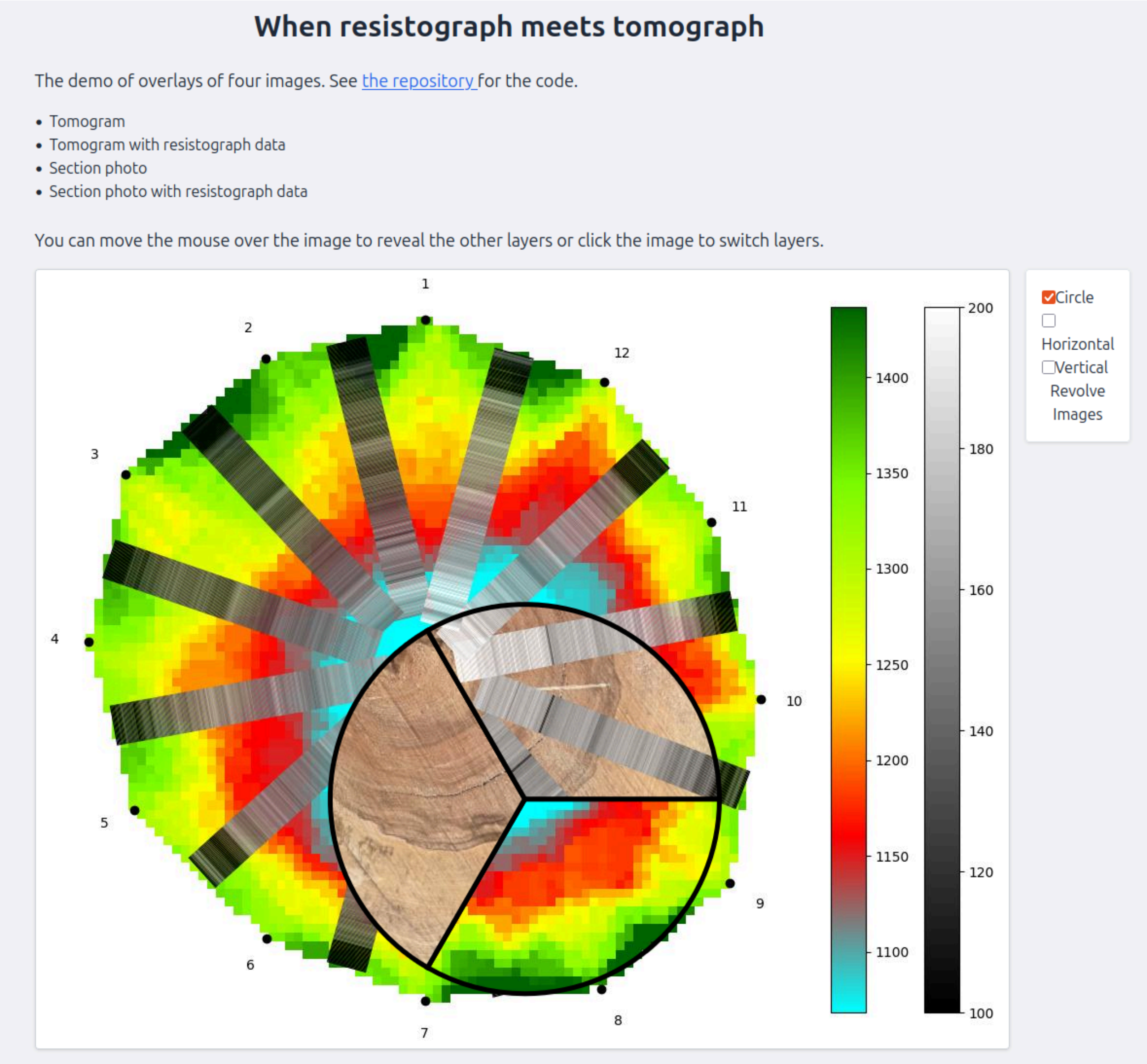
Velocity limits: 836 - 1093 m/s

☑ Calculate automatically

Warning: Green tomogram areas may not be healthy.

Merge data II

- Merge resistograph data with tomograph data.
- Visualize the merged data.
- Look for short or long decreases in resistograph data. This indicates cracks and cavities, respectively.



When resistograph meets tomograph

The demo of overlays of four images. See the repository for the code.

- Tomogram
- Tomogram with resistograph data
- Section photo
- Section photo with resistograph data

You can move the mouse over the image to reveal the other layers or click the image to switch layers.

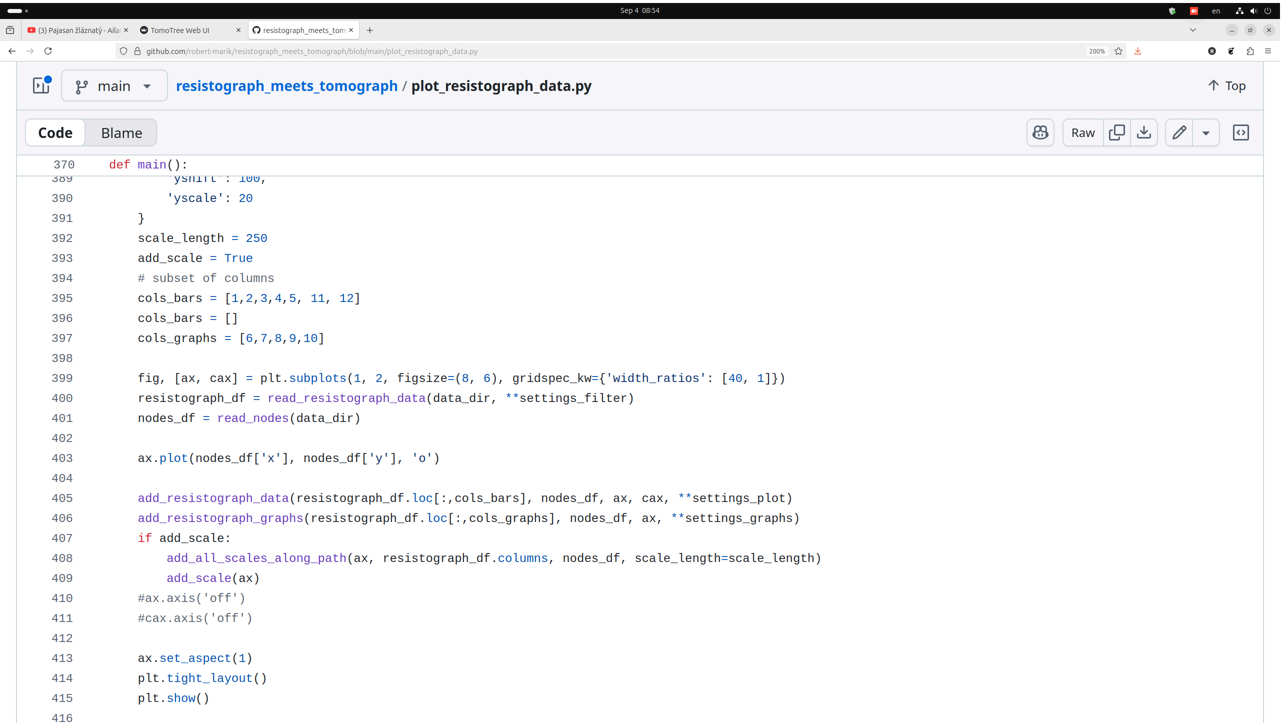
☑Circle
□ Horizontal
□Vertical
Revolve Images

Python library

Advantages

- language widely used in scientific data processing
- many libraries for data processing and visualization
- easy to automate, scale, modify, share and reuse
- easy to integrate with other tools

Python library


github.com/robert-marik/resistograph_meets_tomograph/blob/main/plot_resistograph_data.py
main
resistograph_meets_tomograph / plot_resistograph_data.py
Top
Code
Blame
Raw

```python
def main():
        'yshift': 100,
        'yscale': 20
    }
    scale_length = 250
    add_scale = True
    # subset of columns
    cols_bars = [1,2,3,4,5, 11, 12]
    cols_bars = []
    cols_graphs = [6,7,8,9,10]

    fig, [ax, cax] = plt.subplots(1, 2, figsize=(8, 6), gridspec_kw={'width_ratios': [40, 1]})
    resistograph_df = read_resistograph_data(data_dir, **settings_filter)
    nodes_df = read_nodes(data_dir)

    ax.plot(nodes_df['x'], nodes_df['y'], 'o')

    add_resistograph_data(resistograph_df.loc[:,cols_bars], nodes_df, ax, cax, **settings_plot)
    add_resistograph_graphs(resistograph_df.loc[:,cols_graphs], nodes_df, ax, **settings_graphs)
    if add_scale:
        add_all_scales_along_path(ax, resistograph_df.columns, nodes_df, scale_length=scale_length)
        add_scale(ax)
    #ax.axis('off')
    #cax.axis('off')

    ax.set_aspect(1)
    plt.tight_layout()
    plt.show()
```

Limitations

- requires programming skills
- requires installation of Python, Python IDE and libraries
- no GUI

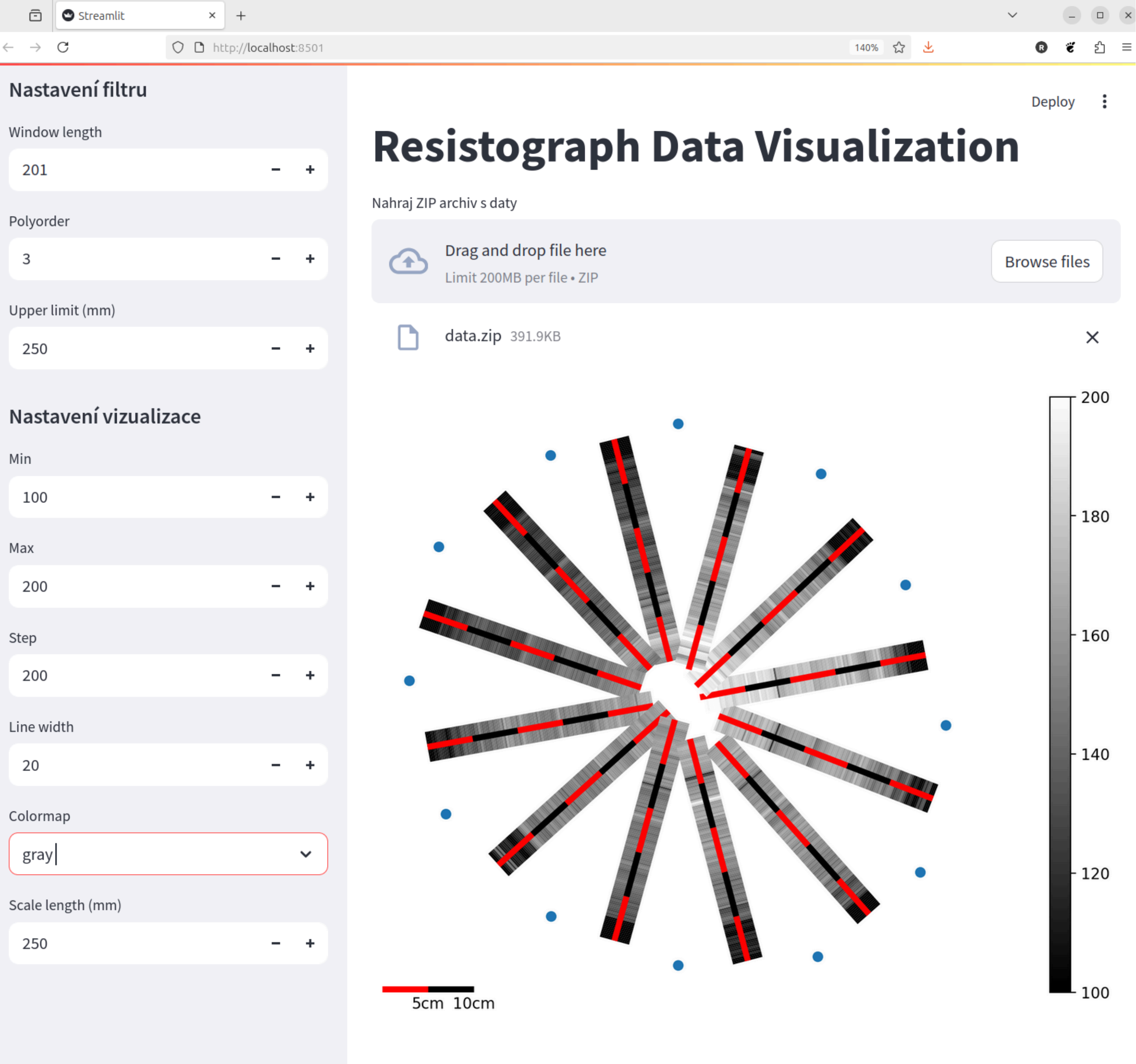
User complaints

- Want to use a GUI. No coding.
- Need simple installation.
- Need easy sharing.

Streamlit

- Python library for building web applications
- easy to use, requires minimal code
- interactive widgets for user input
- real-time updates
- free hosting on Streamlit Cloud
- widely used in data science and machine learning communities
- widely used in industry and academia

Btw: what exactly does it mean "easy to use"?



Nastavení filtru

Window length: 201

Polyorder: 3

Upper limit (mm): 250

Nastavení vizualizace

Min: 100

Max: 200

Step: 200

Line width: 20

Colormap: gray

Scale length (mm): 250

Resistograph Data Visualization

Nahraj ZIP archiv s daty

Vibe coding with ChatGPT

- ChatGPT 5 on August 2025
- communication in Czech
- web app in 2 prompts

```
Mam nasledujici knihovnu. Napis streamlit
program, ktery umozni nahrat zazipovany
adresar s daty a spusti na nem prikazy
odpovidajici main funkci. Vystup se zobrazi.
```

```
OK. V levem panelu chci mit moznost menit
prednastavene volby.
```

Docker

A containerization platform

- packages application and its dependencies into a container
- ensures consistency across different environments
- easy to share and deploy
- widely used in industry and academia
- starts a container with a single command in miliseconds

Running dockerized app

```
docker compose up
```

Advantages

- 🚫 No Python install
- 🚫 No dependency issues
- 🖥️ Works on Win / Mac / Linux
- 📂 Just clone repo with `Dockerfile` and `docker-compose.yml`
- ⏳ First run = minutes, later = ms

Summary

- Resistograph and tomograph are complementary tools for tree stem inspection
- Merging data from both devices provides a more comprehensive understanding of stem condition
- A Python library was developed to facilitate data merging and visualization
- Streamlit can be used to create a user-friendly web application for non-programmers
- Docker ensures easy installation across different systems