



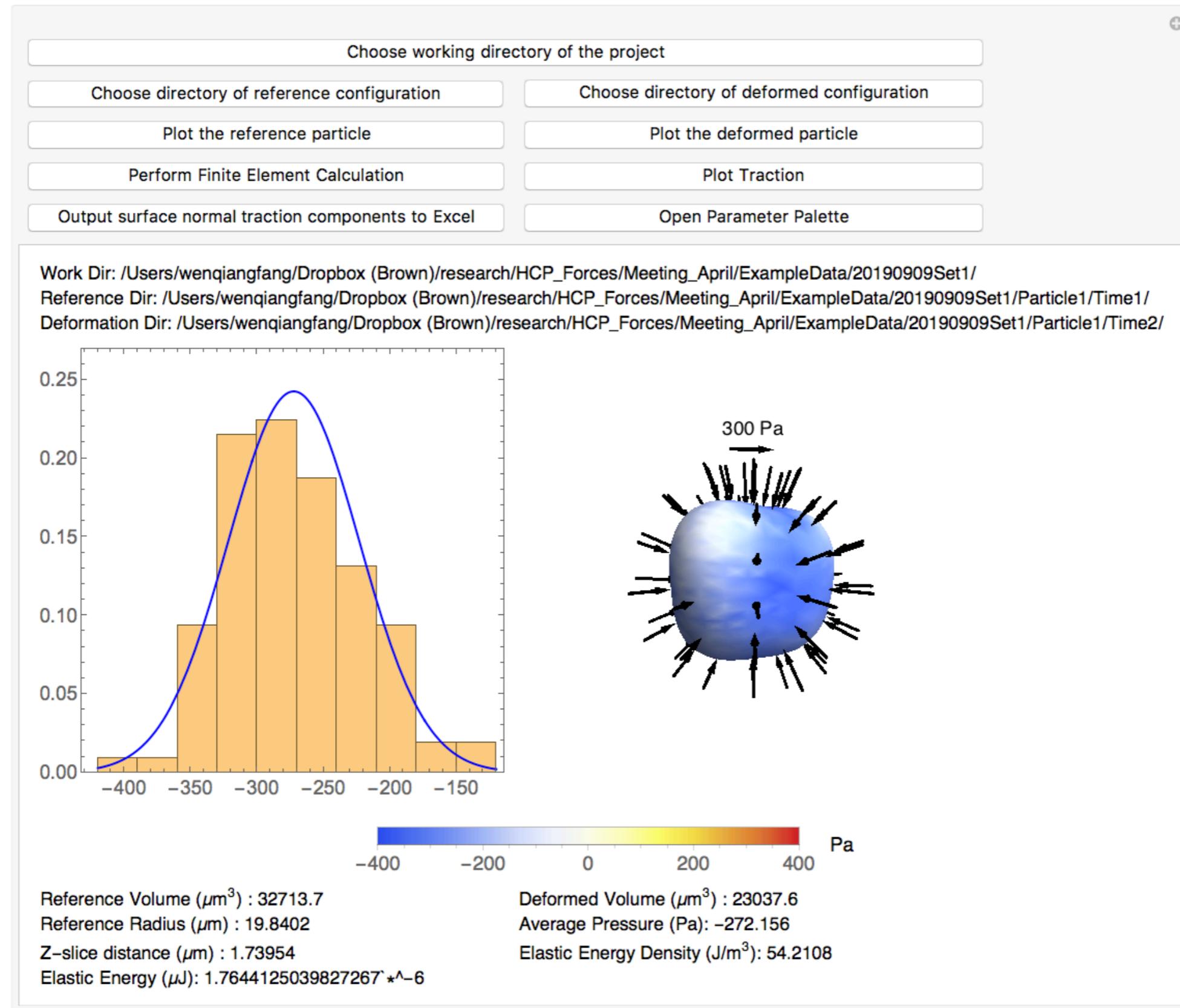
Mathematica GUI (graphical user interface) for HCMP data processing

Wenqiang Fang

Advisor: Prof. Haneesh Kesari



GUI at a glance





BROWN

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wqfang / HCMP_Project

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HCMP Project GUIs Edit

Manage topics

11 commits 2 branches 0 packages 0 releases 1 contributor GPL-3.0

Branch: master New pull request Create new file Upload files Find file Clone or download

File/Folder	Description	Last Commit
wqfang GUI update/		Latest commit 5d7b3ba 9 hours ago
GUI	GUI update/	9 hours ago
document	add instruction	10 hours ago
src	src/	11 hours ago
.gitignore	add instruction	10 hours ago
LICENSE	Create LICENSE	14 hours ago
README.md	Update README.md	10 hours ago

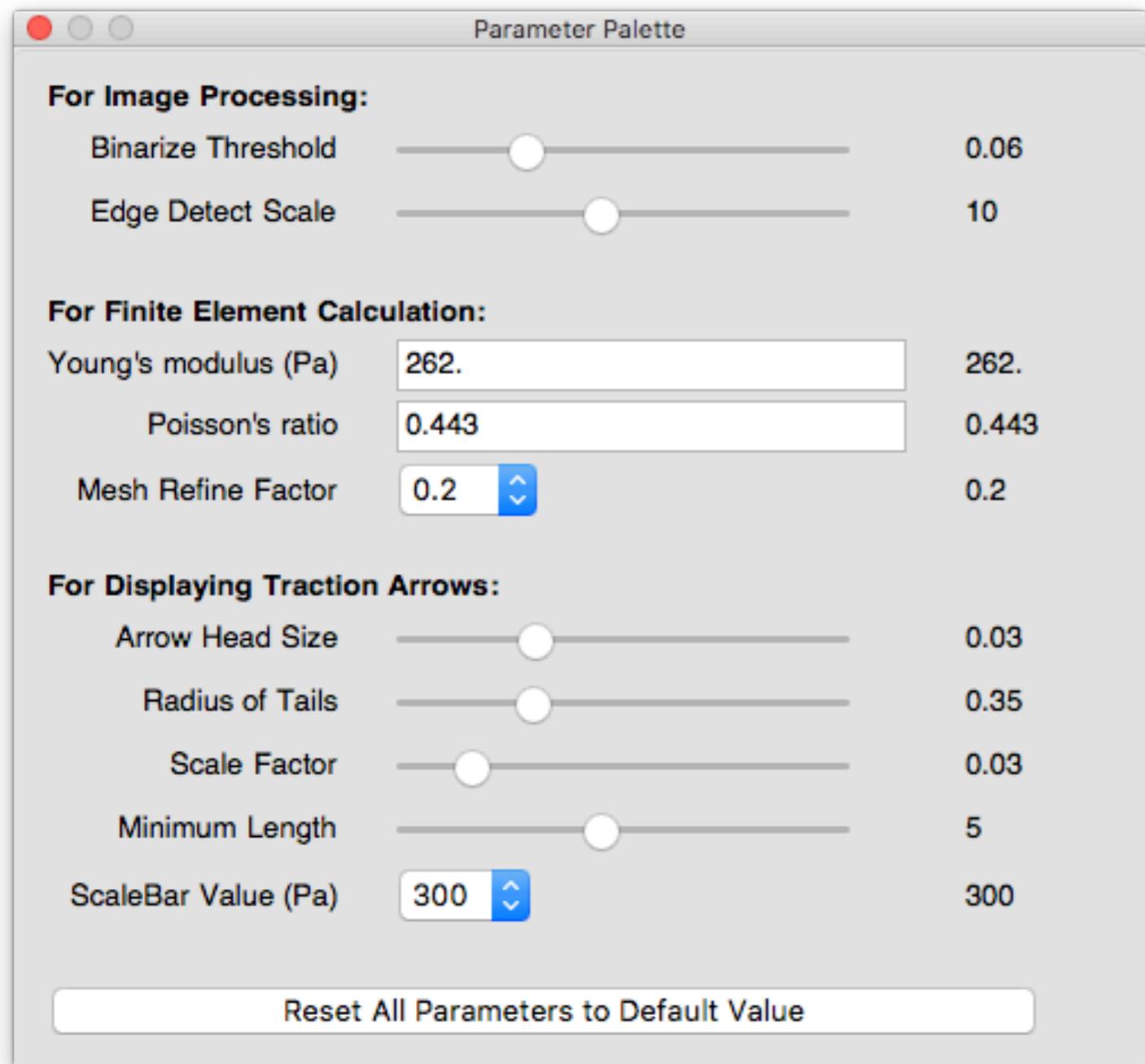
README.md

HCMP Project GUIs

This repository stores the GUIs for HCMP Project. In the `GUI` folder, there are two Mathematica Notebooks:

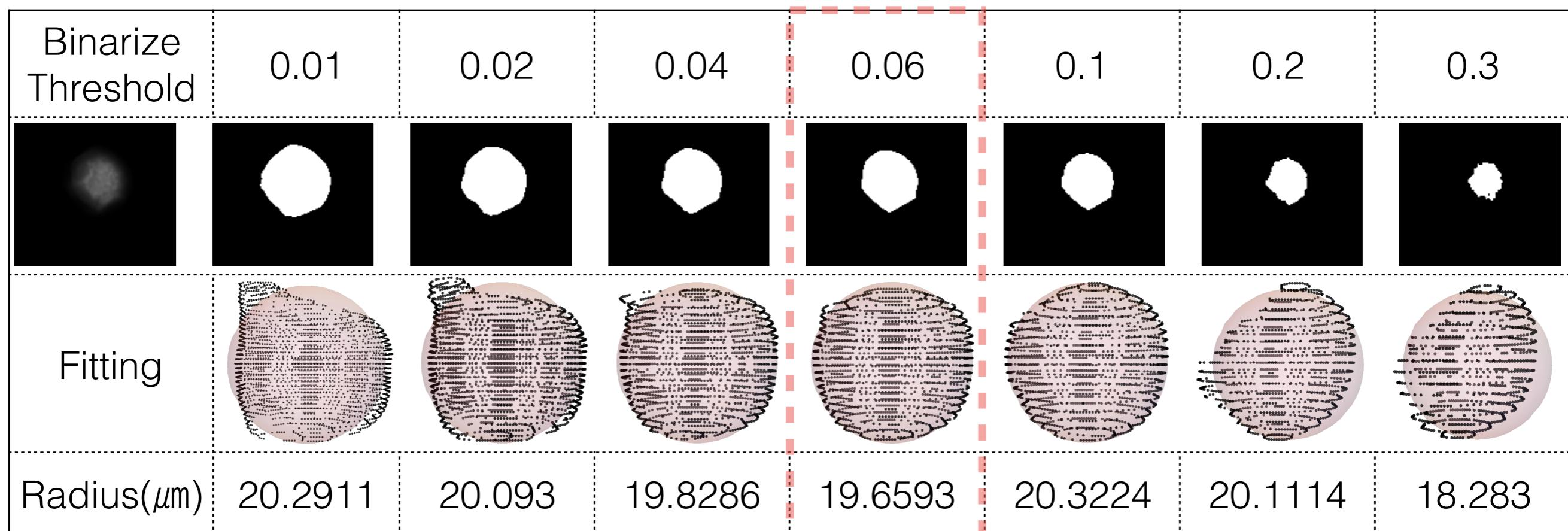
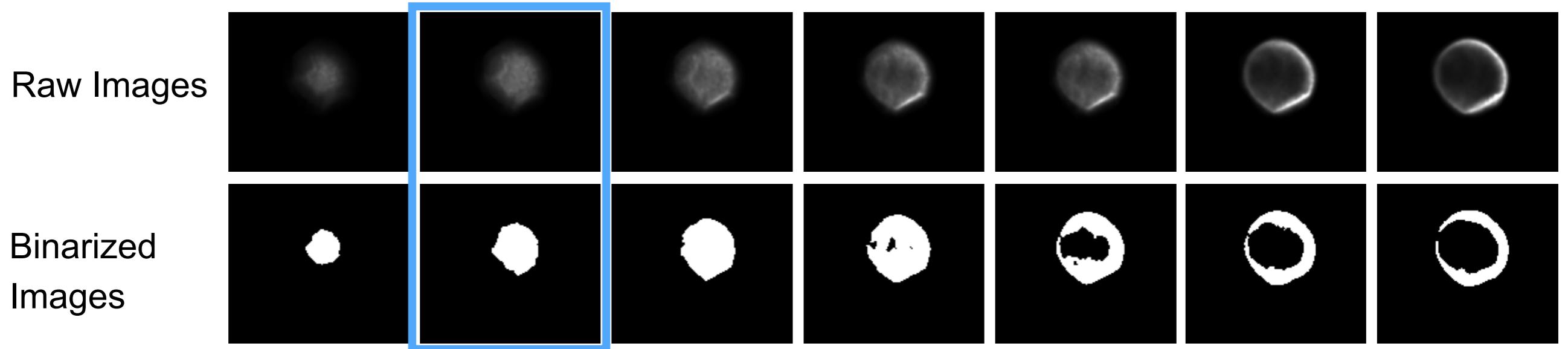
- `HCMP_GUI.nb`
- `ParallelProcessing_GUI.nb`

Parameter Palette introduction

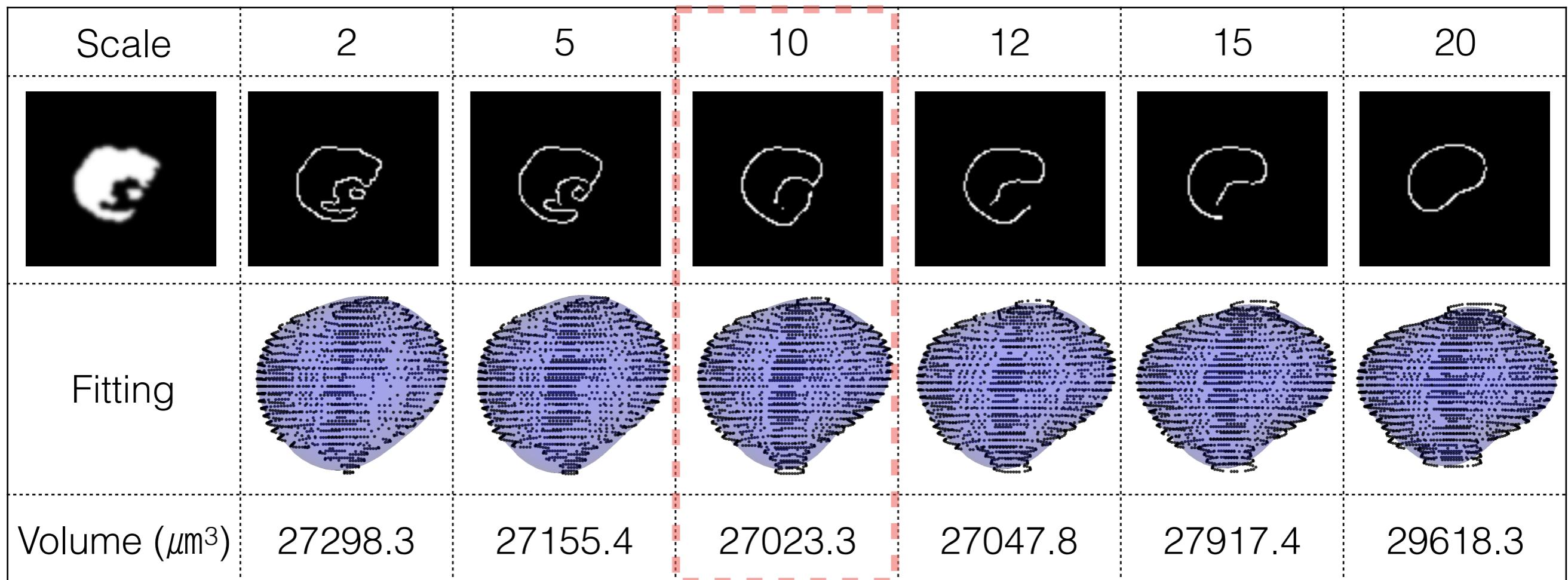
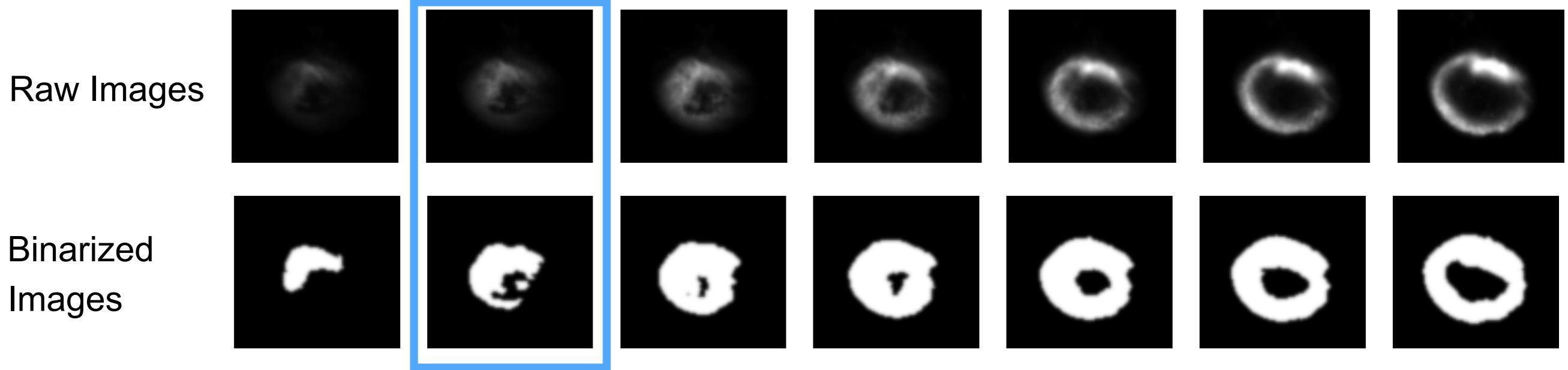


In case the default settings do not give you great result, try to tune these parameters.

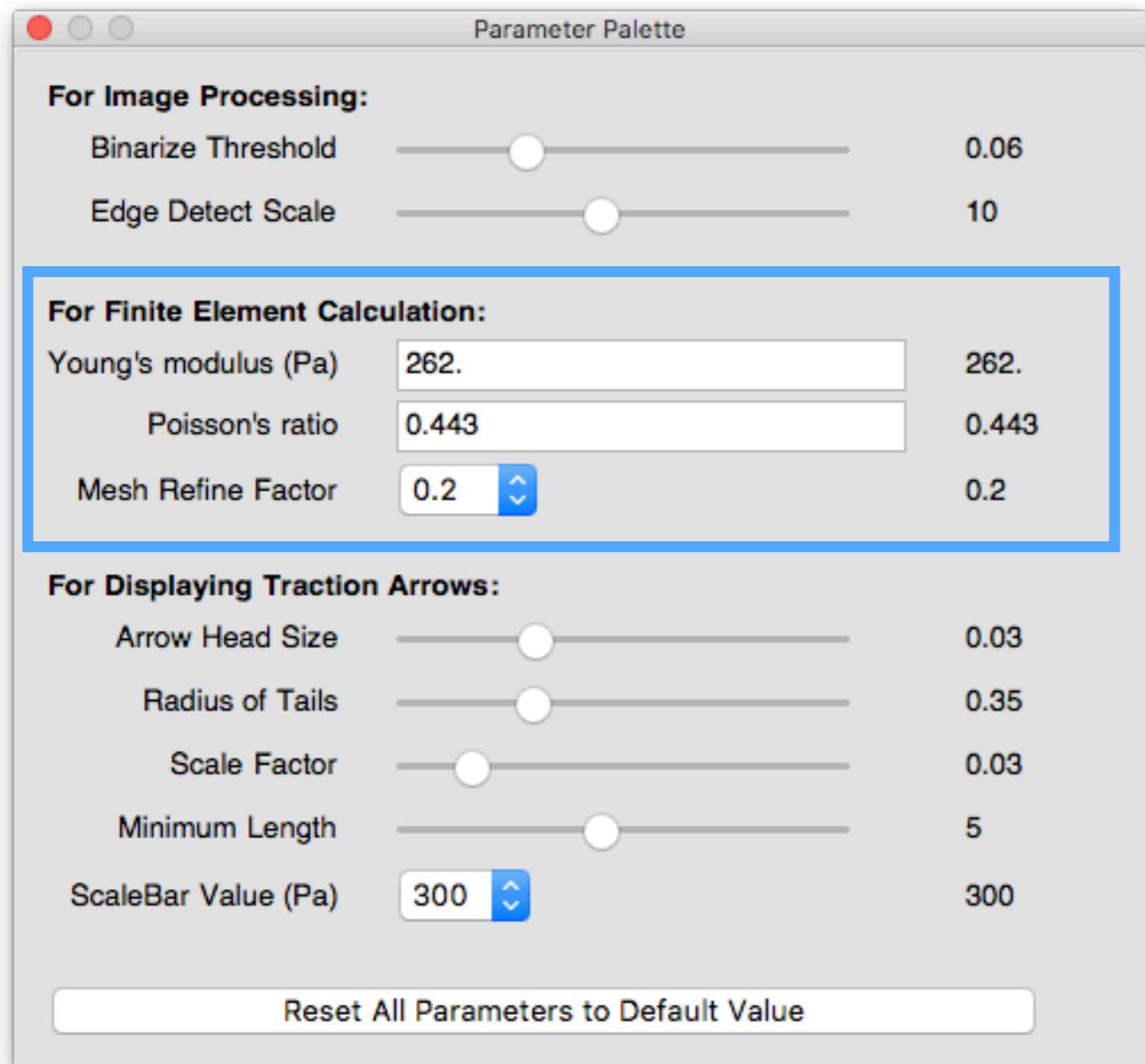
Binarize Threshold



Edge Detect Scale

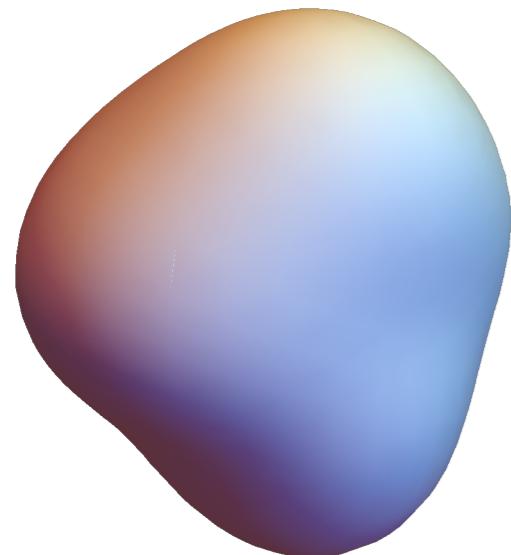


Parameter Palette introduction



In case the default settings do not give you great result, try to tune these parameters.

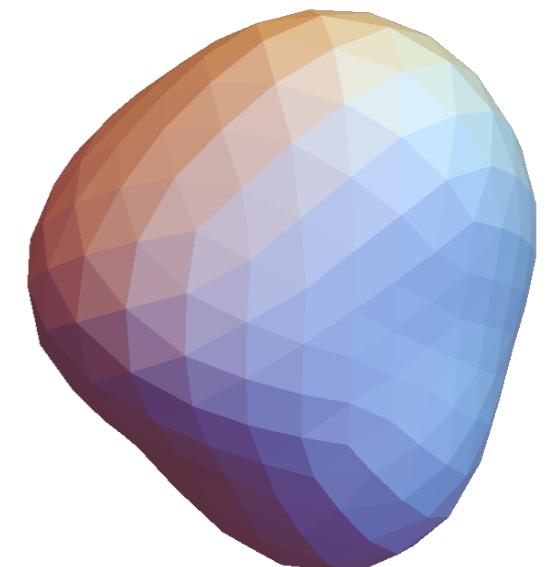
Mesh Refine Factor (h)



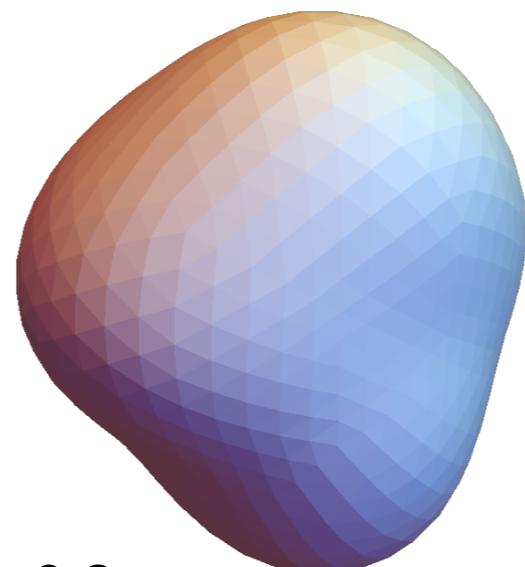
Analytical fitting surface



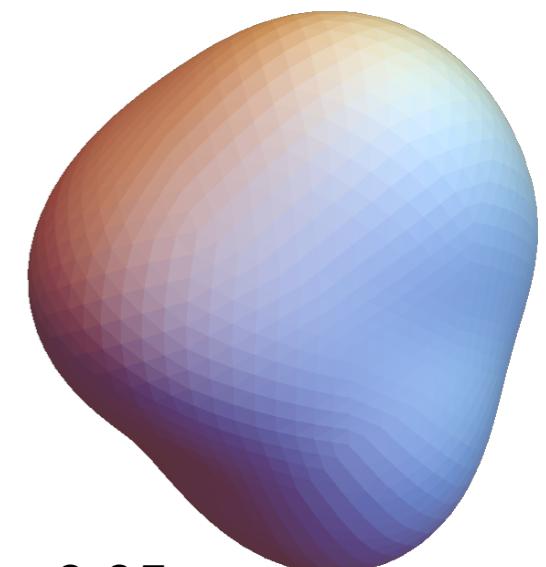
$h = 5$



$h = 1$

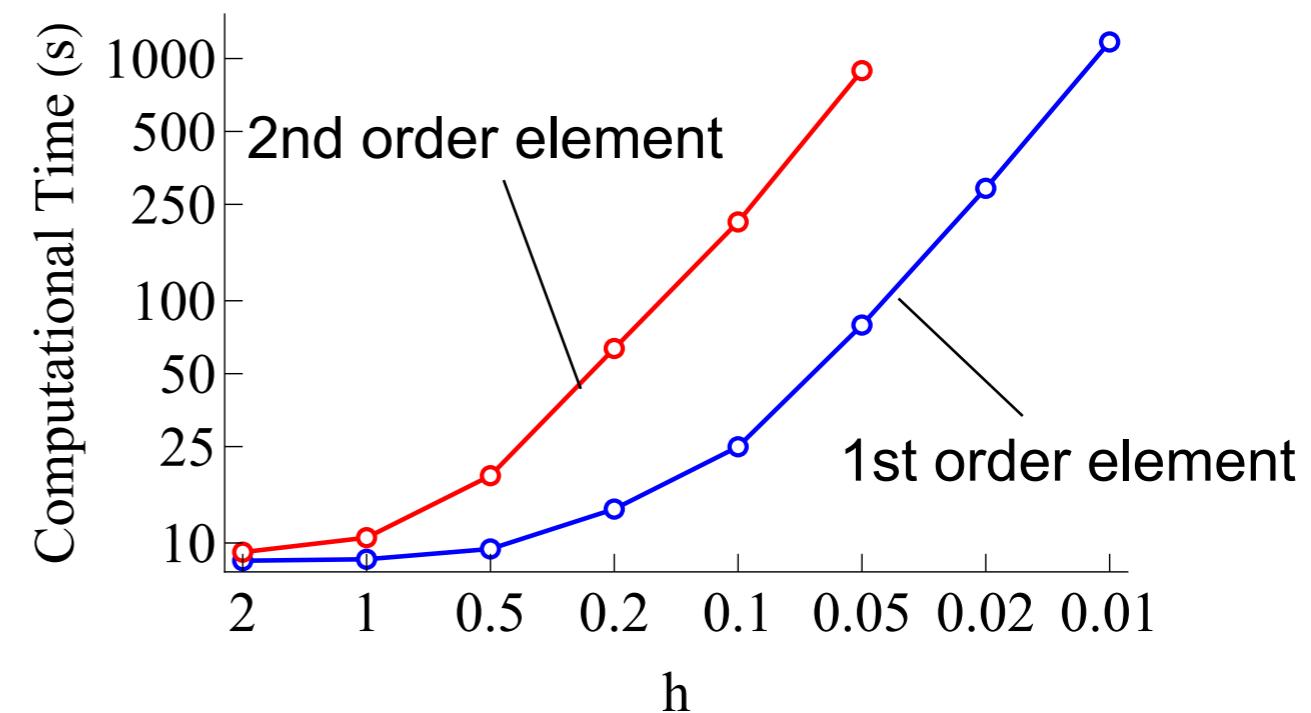
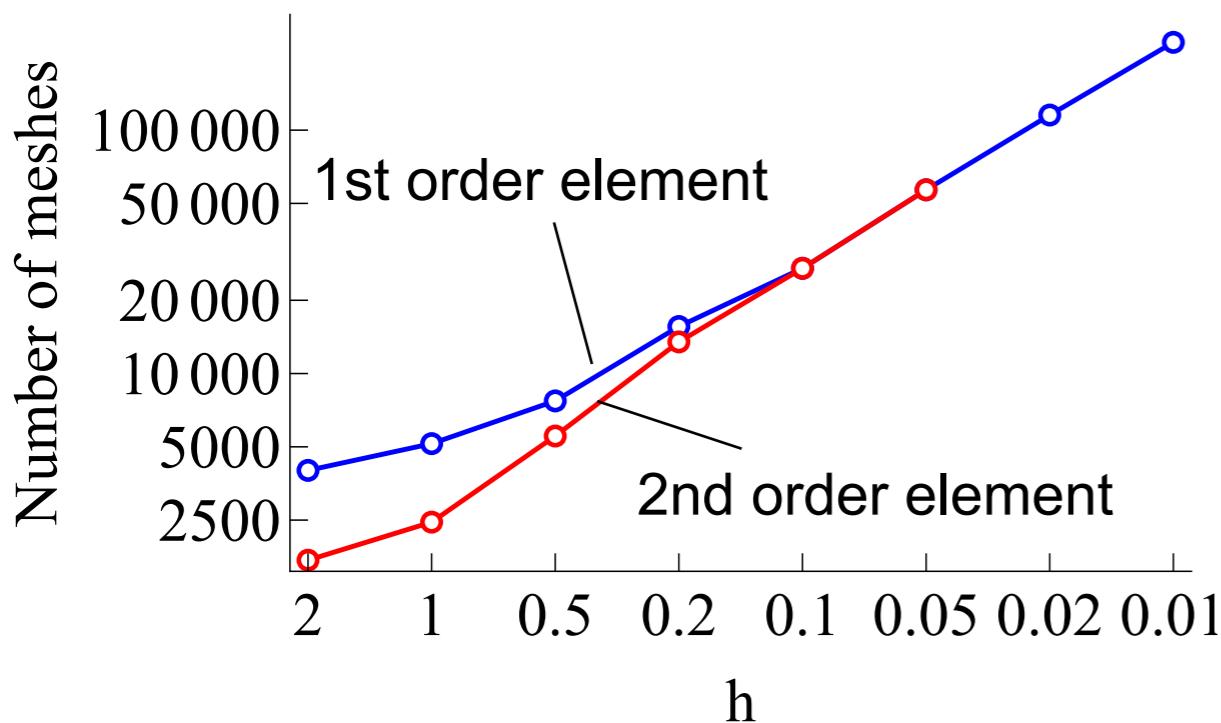
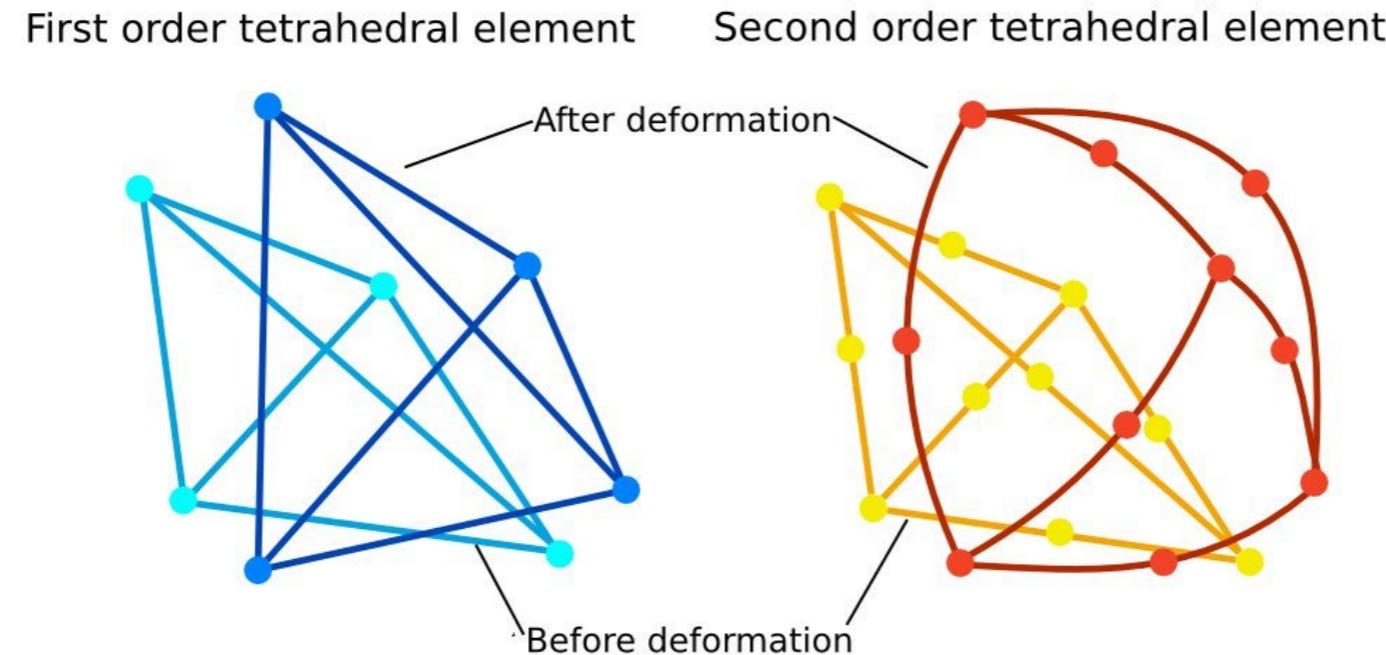


$h = 0.2$

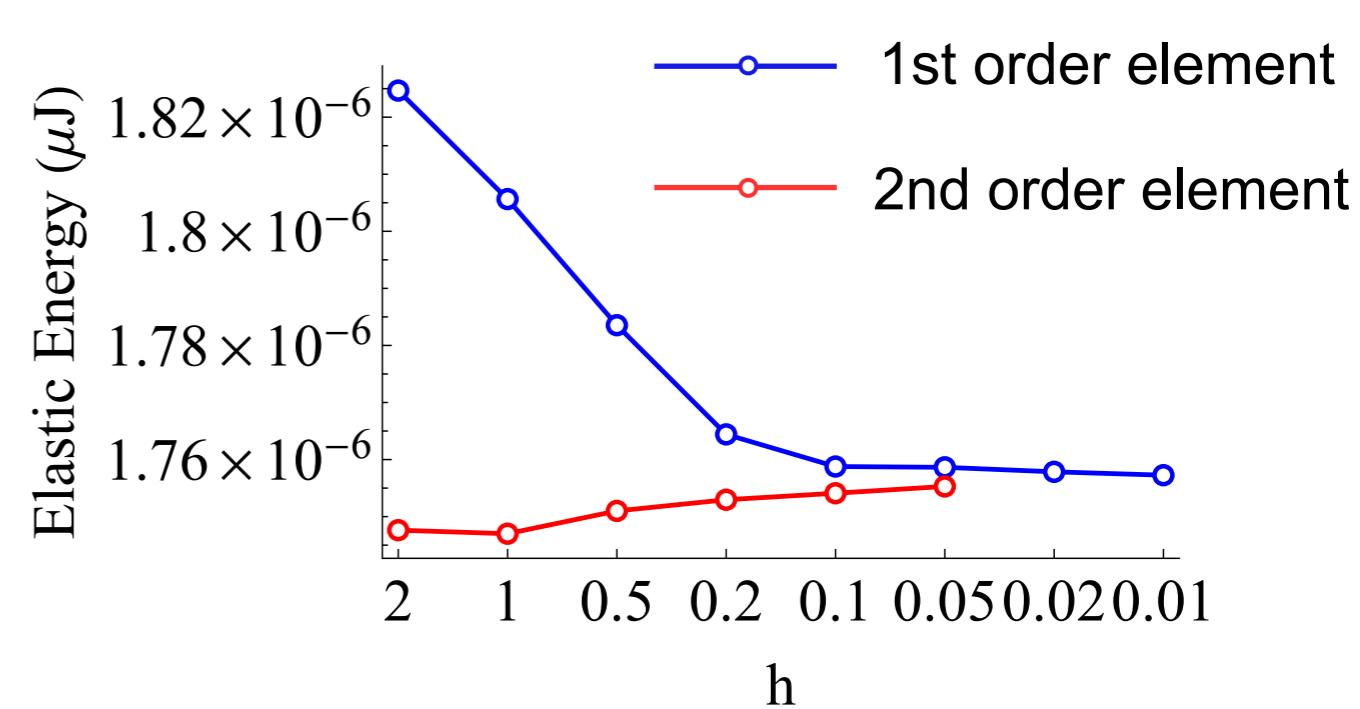
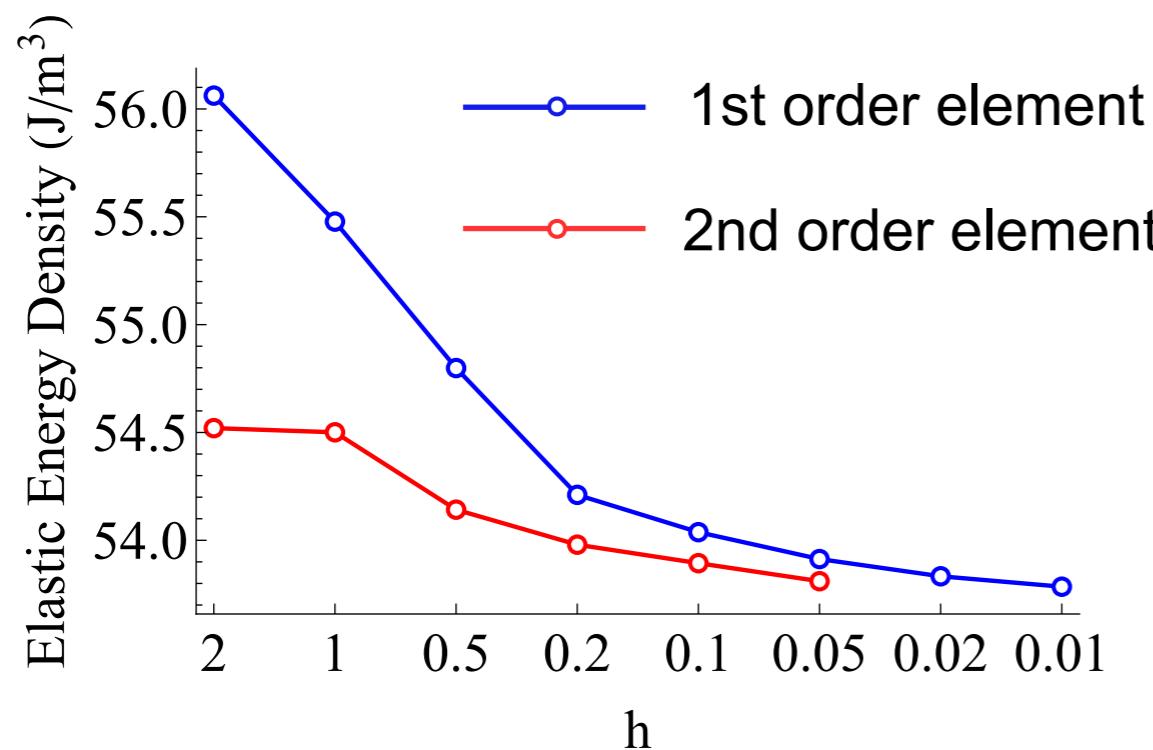
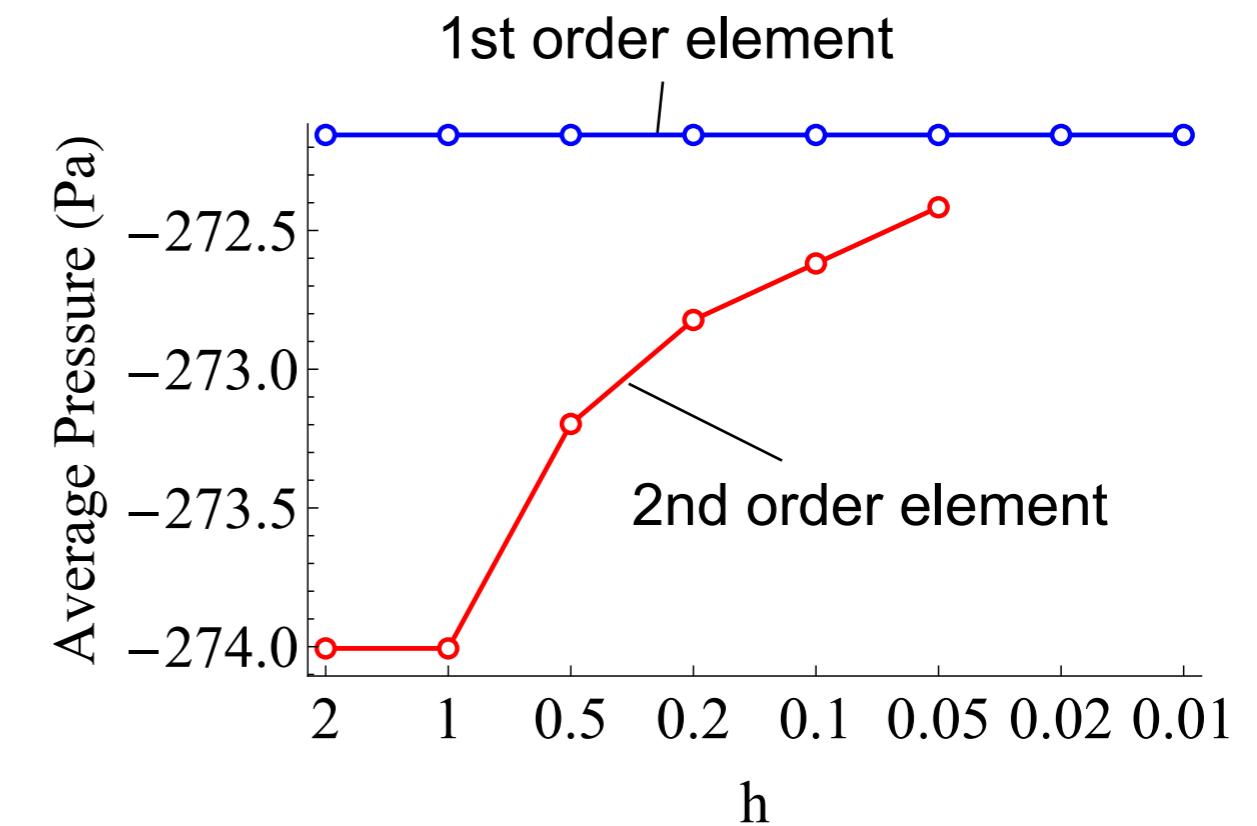
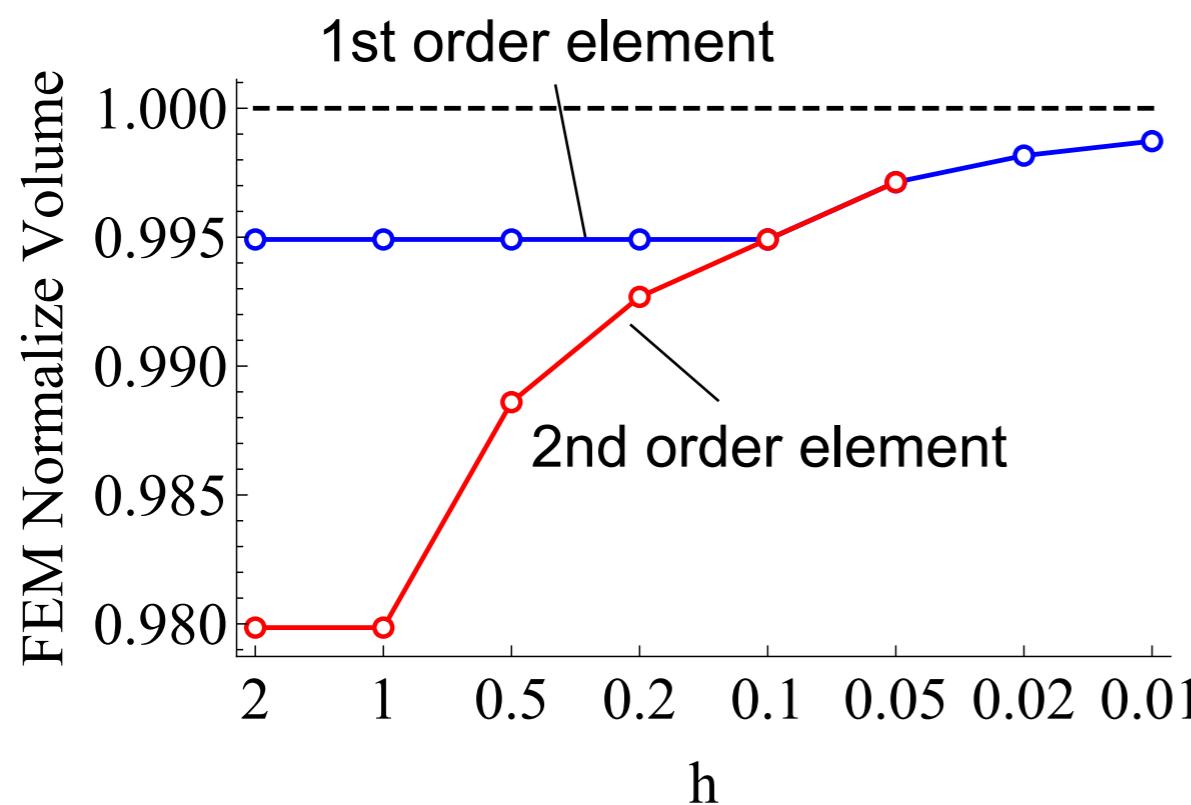


$h = 0.05$

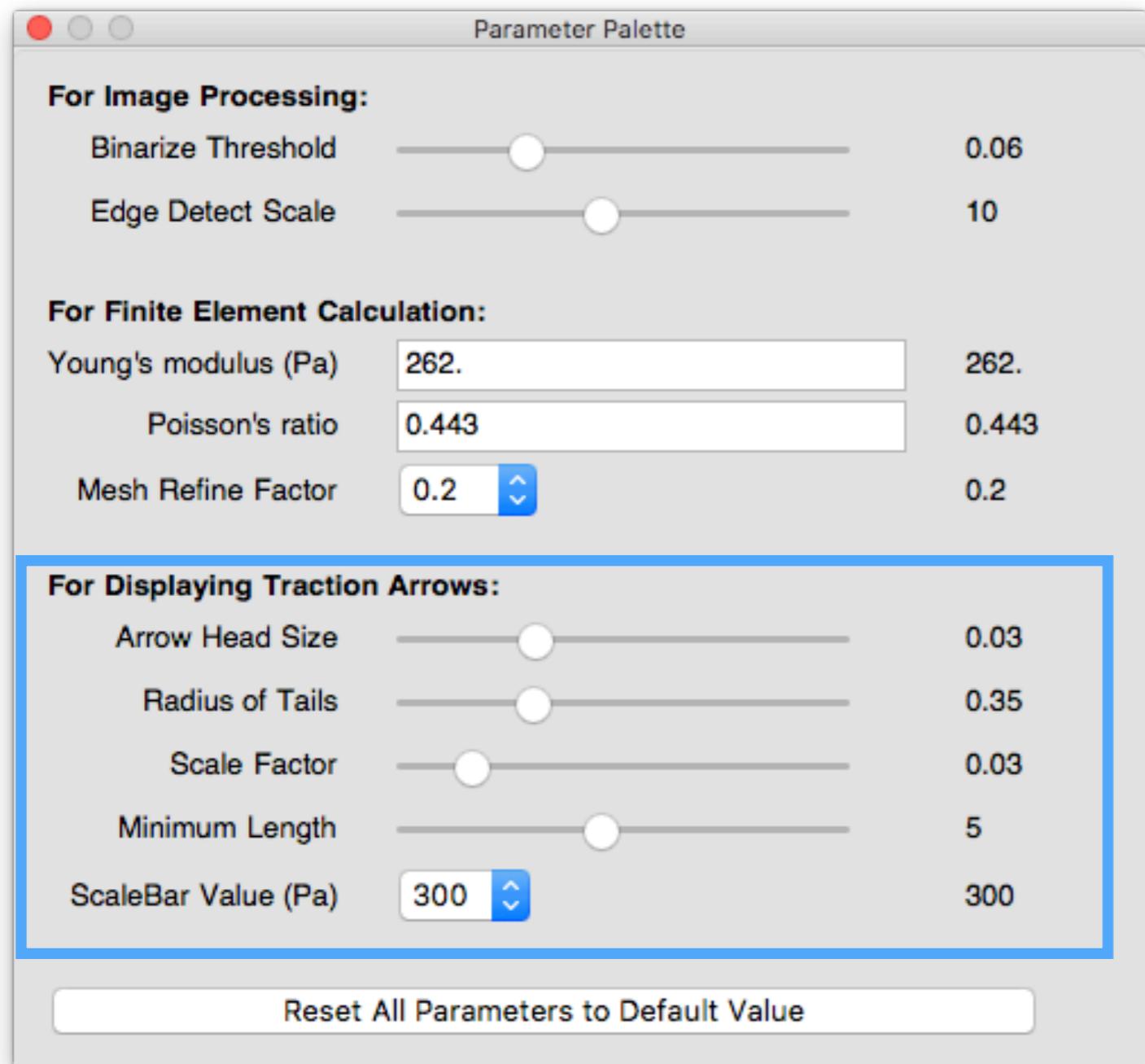
Mesh Order (p)



h-p Study

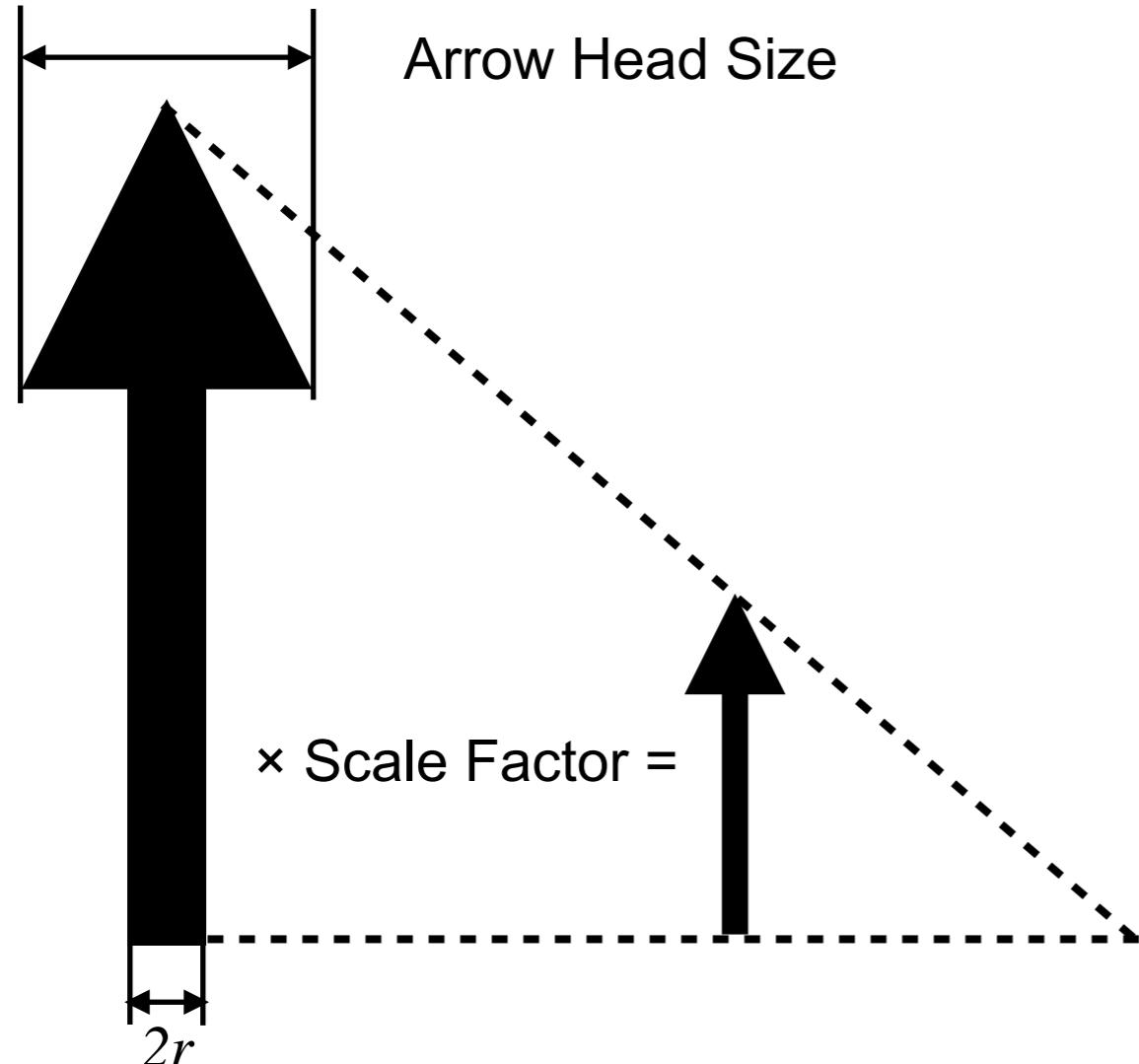


Parameter Palette introduction



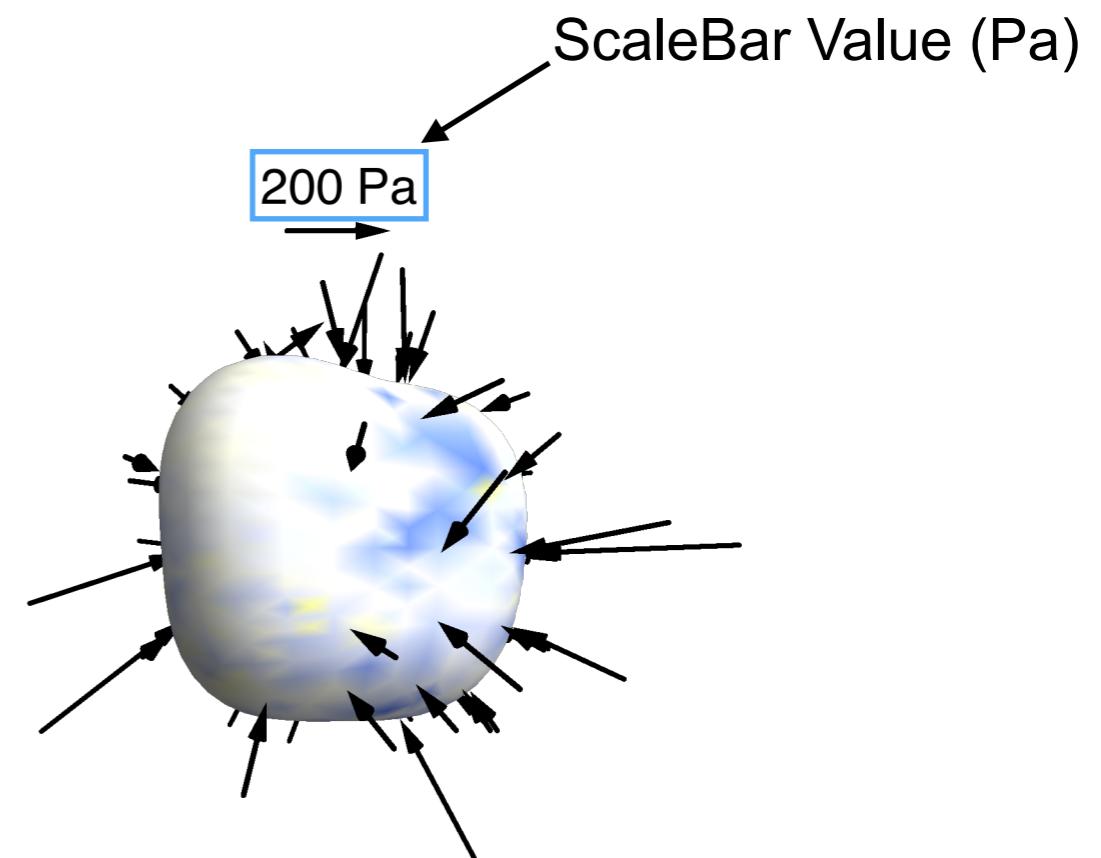
In case the default settings do not give you great result, try to tune these parameters.

Arrow plot parameters



Radius of Tails

Arrows shorter than **Minimum Length** are not shown



Parallel processing of massive data set



Parallel processing of massive data set

Choose working directory of the project

Prefix for Particle folders Particle

Prefix for Time folders Time

Calculate the Number of Beads and Deformed Configurations

Mesh Refine Factor 0.05

Perform Finite Element Calculation

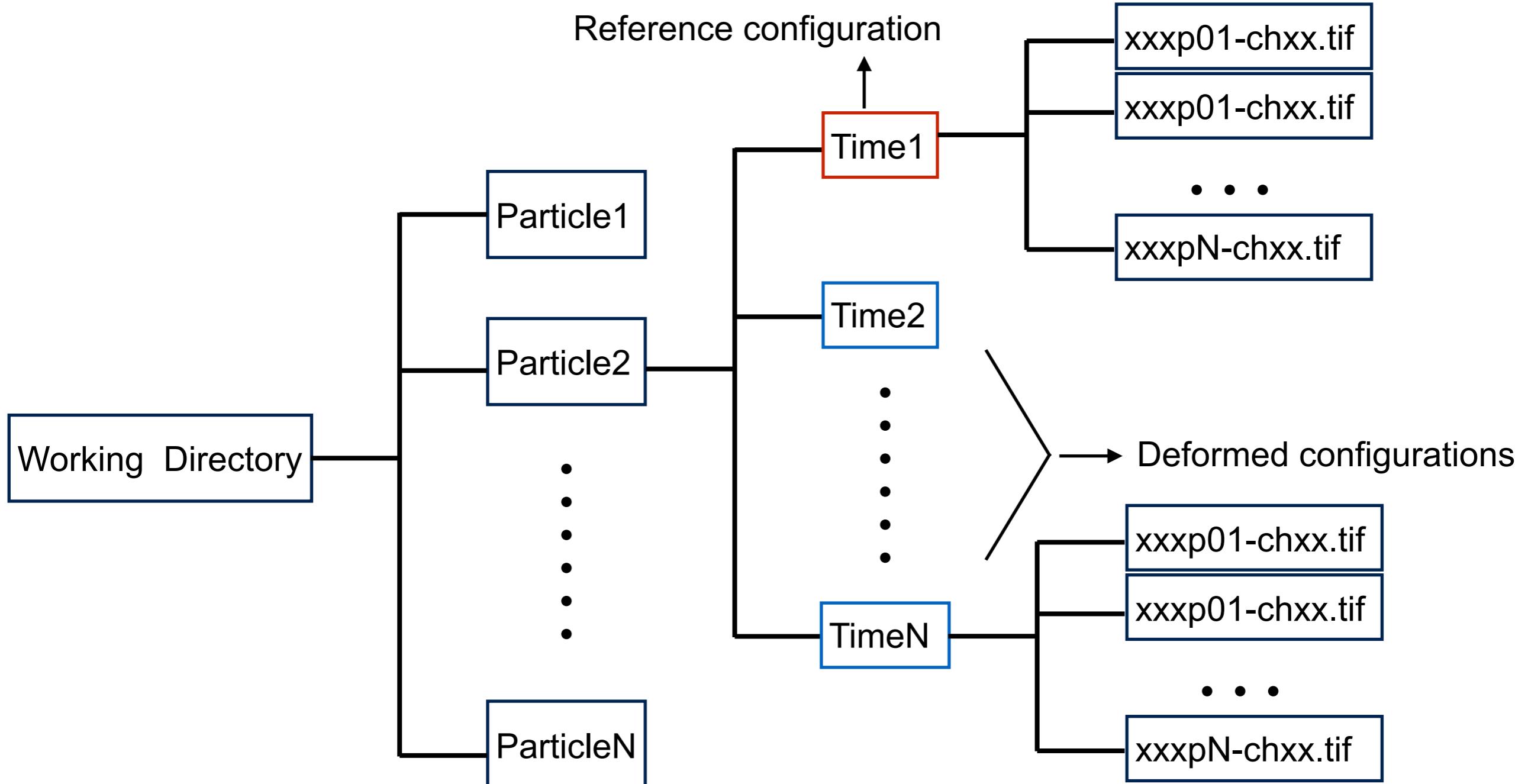
Output Results to Excel

Work Dir: Null
Number of Particles: 0
Number of Deformed Configurations: 0

- User-defined directory prefix
- Perform all image processing and finite element calculations after one click
- Parallel computation (time scale factor depends on No. of CPU)
- Output only the essential results to Excel file (Diameter, Volume, Average Pressure, Elastic Energy Density, Elastic Energy)



Directory structure



Average pressure and Normal traction component calculation

Pressure $p(\mathbf{x}) = \frac{1}{3} \text{tr} (\boldsymbol{\sigma}(\mathbf{x})),$

Average Pressure $\langle p \rangle = \frac{1}{\text{vol}(\mathcal{B}_0)} \int_{\mathcal{B}_0} p(\mathbf{x}(X)) d\Omega_0,$

Traction Vector $\mathbf{t}(\mathbf{x}, \mathbf{n}(\mathbf{x})) = \boldsymbol{\sigma}(\mathbf{x})\mathbf{n}(\mathbf{x}),$

Normal traction component $t_n(\mathbf{x}, \mathbf{n}(\mathbf{x})) = \mathbf{n}(\mathbf{x})\boldsymbol{\sigma}(\mathbf{x})\mathbf{n}(\mathbf{x}),$

where $\boldsymbol{\sigma}$ is the Cauchy stress tensor, $\text{Vol}(\mathcal{B}_0)$ is the volume of \mathcal{B}_0 ,
which is a stress-free state of HCMP.

Elastic energy and Elastic energy density calculation

Stored Elastic Energy $\Pi = \int_{\mathcal{B}_0} \frac{\lambda}{2} \left(\text{tr} (\mathbf{E}(X)) \right)^2 + \mu \text{tr} (\mathbf{E}(X) \mathbf{E}(X)) d\Omega_0,$

where $\mathbf{E}(X) \approx \left(\mathbf{u}'(X) + \mathbf{u}'^T(X) \right)/2$, and μ, λ are Lame's parameters.

We use values of 705.56 Pa and 90.78 Pa, respectively, for these parameters.

Elastic Energy Density $\hat{\Pi} = \frac{1}{\text{vol}(\mathcal{B}_0)} \Pi .$

We can derive that, if assuming only hydrostatic deformation,

$$\hat{\Pi} = \frac{3(1 - 2\nu)}{2E} \langle p \rangle^2 .$$