# Design and analysis of a cooling system in Suzanne's head

Submission for the Community Christmas Competition II proposed by József Nagy

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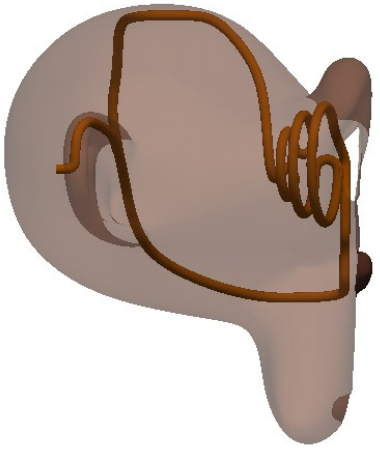
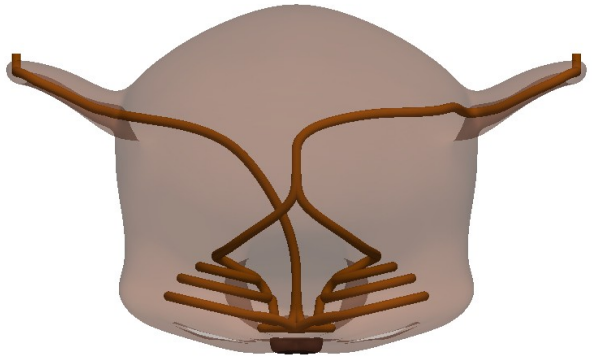
November 20th, 2018

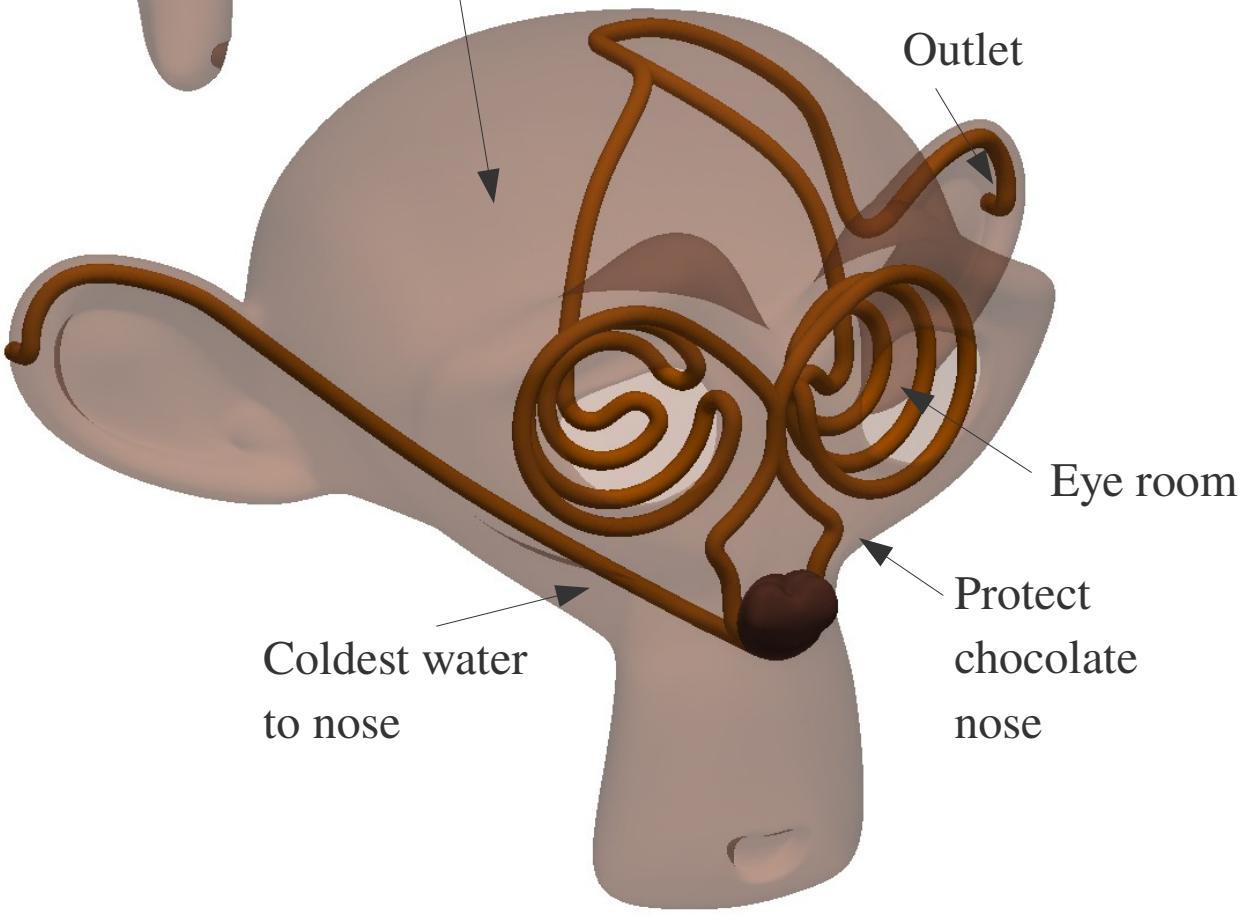
LNMS
Laboratory for numerical modelling and simulation

# Design





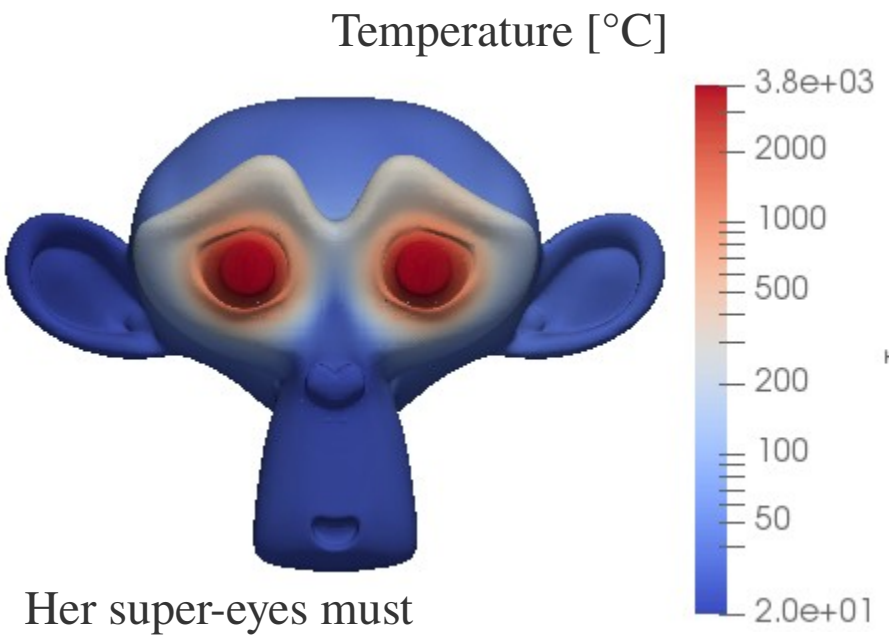
Nose detail



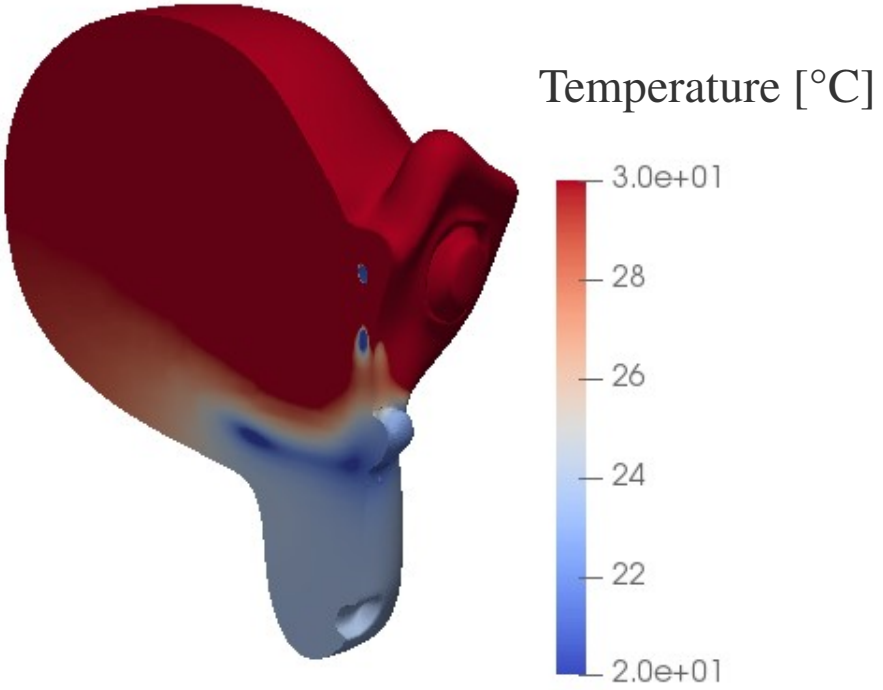

## Specifications:

Material: UHMWPE
(biocompatible, tough, deformable)
Outer diameter: 4.4 mm
Thickness: 0.5 mm
Water flow rate: 4.5 $cm^3/s$

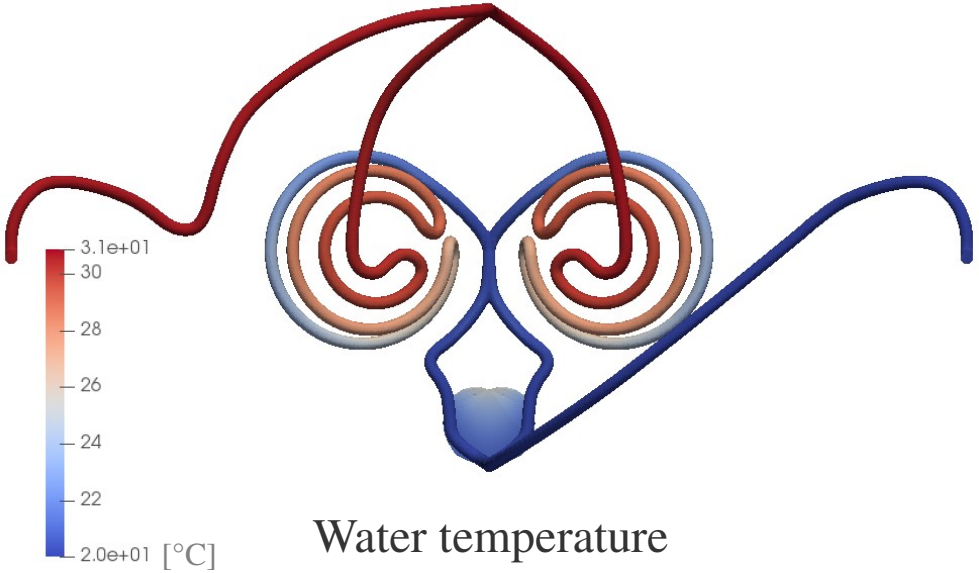
# Results



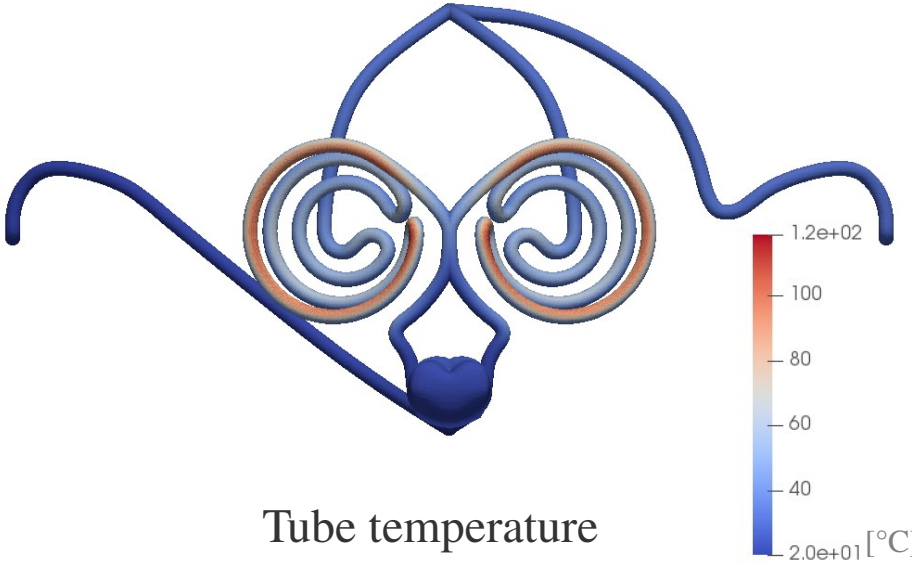

Her super-eyes must withstand a *very* high temperature because tissue is a poor thermal conductor.




Her nose did not reach 30°C.

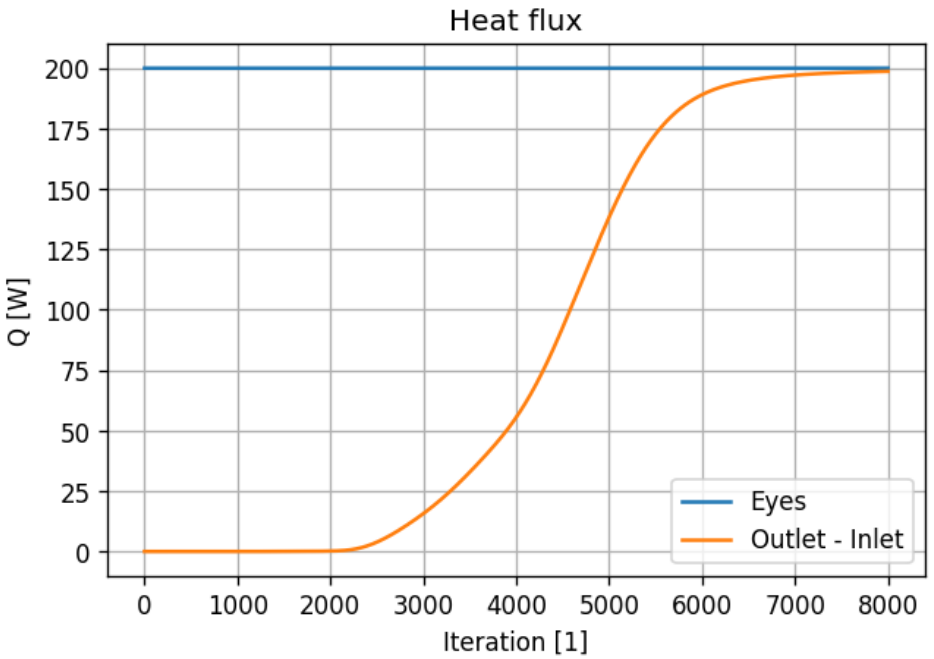



Water temperature

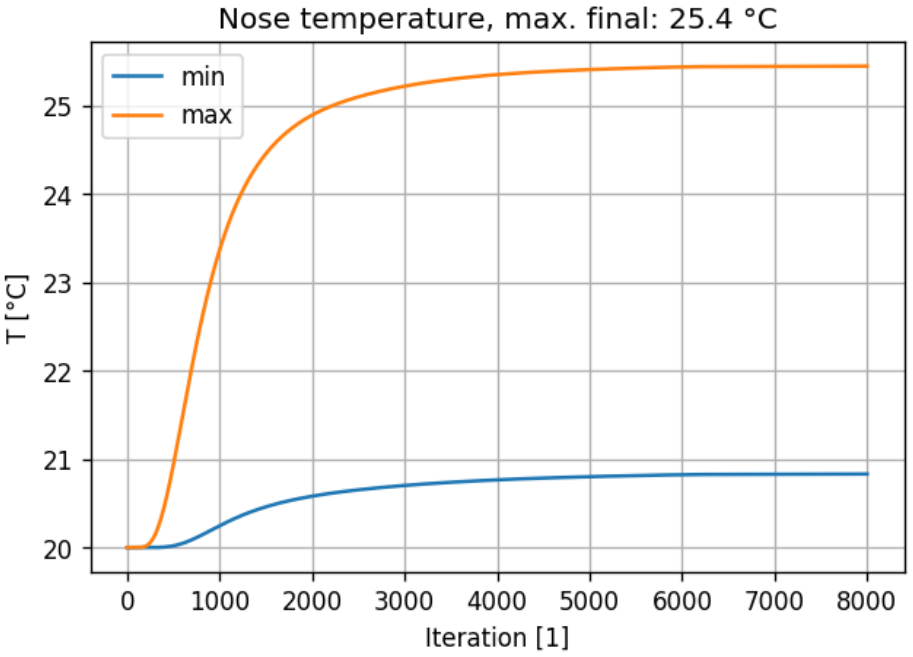



Tube temperature

# Results




The difference in the convected heat between the outlet and the inlet converged to the value of the heat flux imposed on the surface of her eyes, indicating heat conservation and steady state convergence.

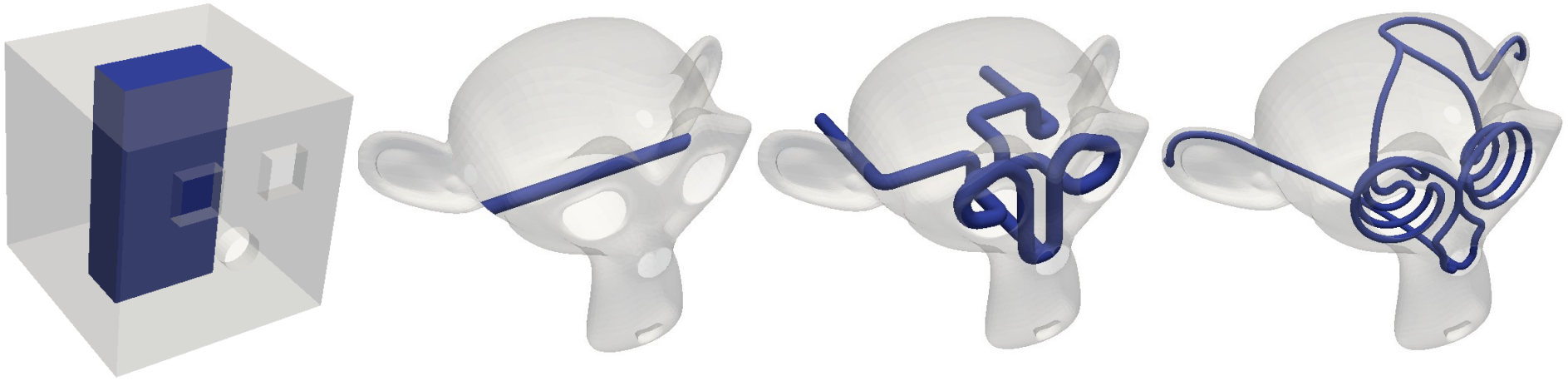



The maximum nose temperature converged to 25.4 °C.

# Conclusion

- Suzanne's chocolate nose will be fine!
- This was fun! *Thank you*, József, for helping us learn!

# Appendix A: evolution



# Appendix B: material data

| Material | Thermal conductivity [W $m^{-1}$ $K^{-1}$] | Specific heat [J $kg^{-1}$ $K^{-1}$] | Density [kg $m^{-3}$] |
|---|---|---|---|
| UHMWPE | 0.41 | 1800 | 930 |
| Chocolate | 0.27 | 2000 | 1260 |
| Tissue | 0.50 | 3600 | 1040 |