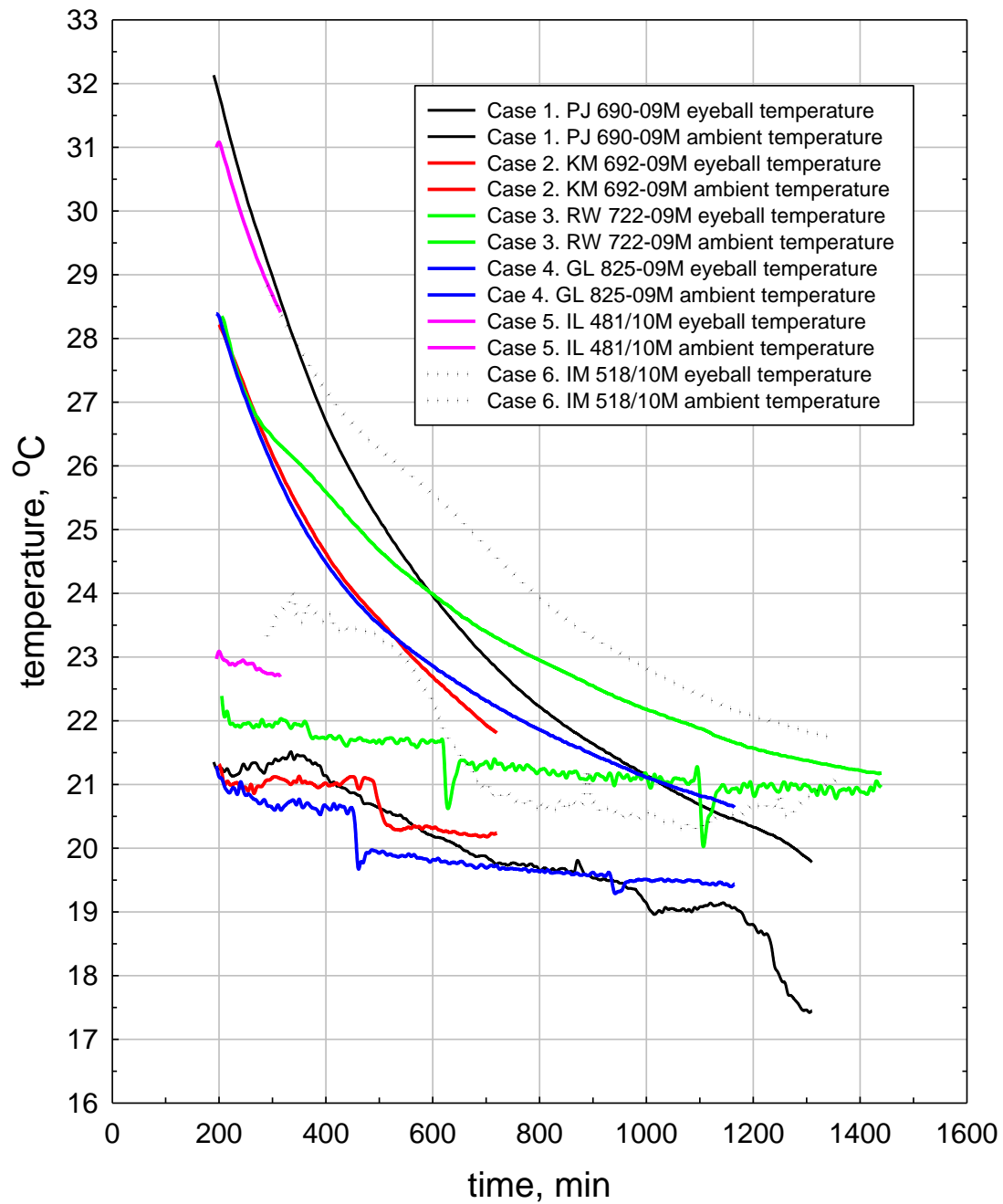


# PREDICTION OF TIME OF DEATH USING A HEAT TRANSPORT MODEL

- Jim Smart, University of Kentucky
- Michal Kaliszan, Medical University of Gdansk, Poland

# POSTMORTEM TEMPERATURE DECAY CURVES

- Six males; known circumstances of death and known ambient temperature.
- Temperature recording ~ 3 hours from TOD.
- Temperature measurements under controlled laboratory conditions (both eyeballs and rectal).



# HEAT TRANSPORT THEORY

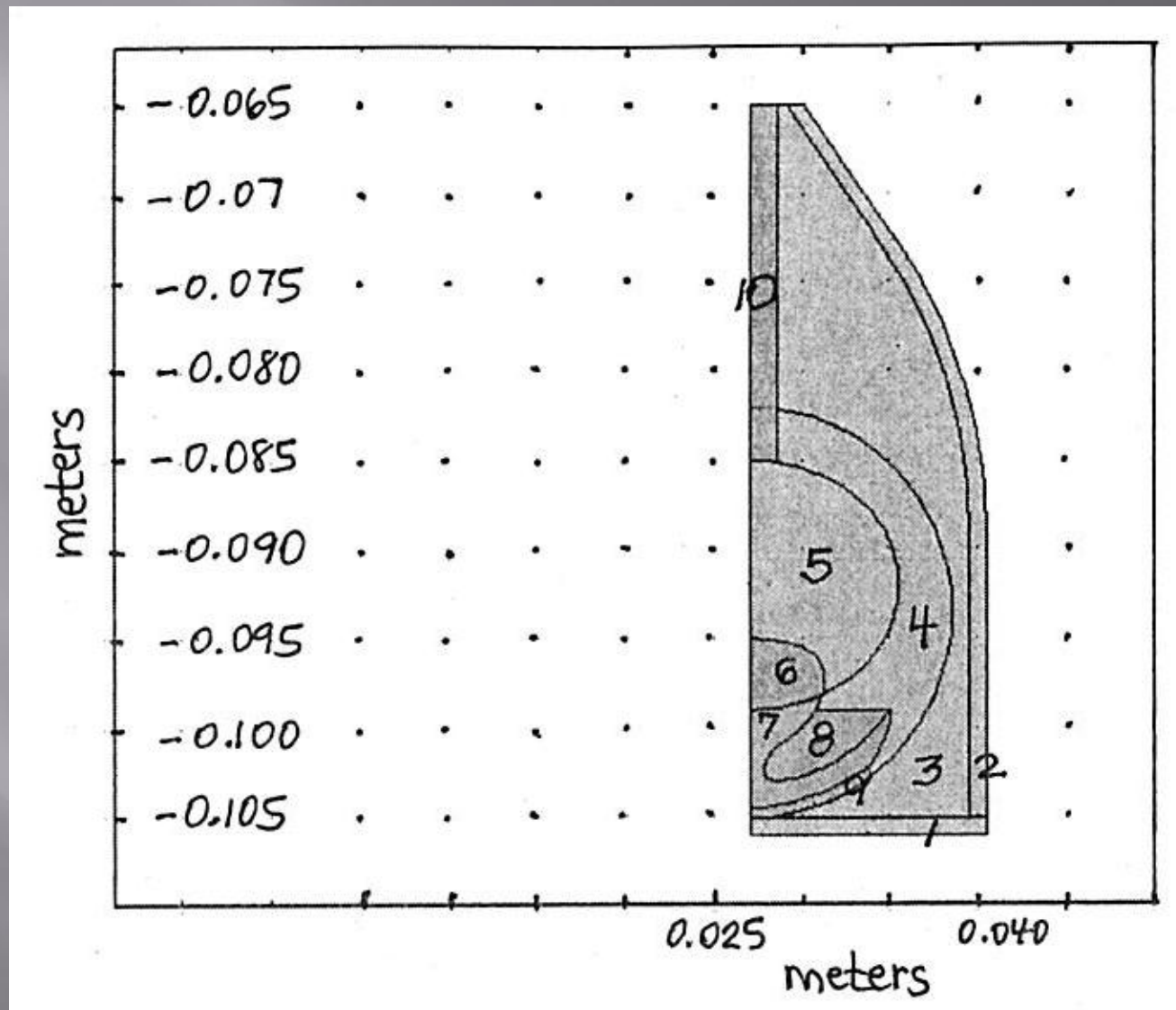
- Governing equations (unsteady state heat transfer).
- Temperature gradients and driving forces.
- Heat transfer coefficients (constant or variable).

# MODEL CONSTRUCTION WITH COMSOL 4.0

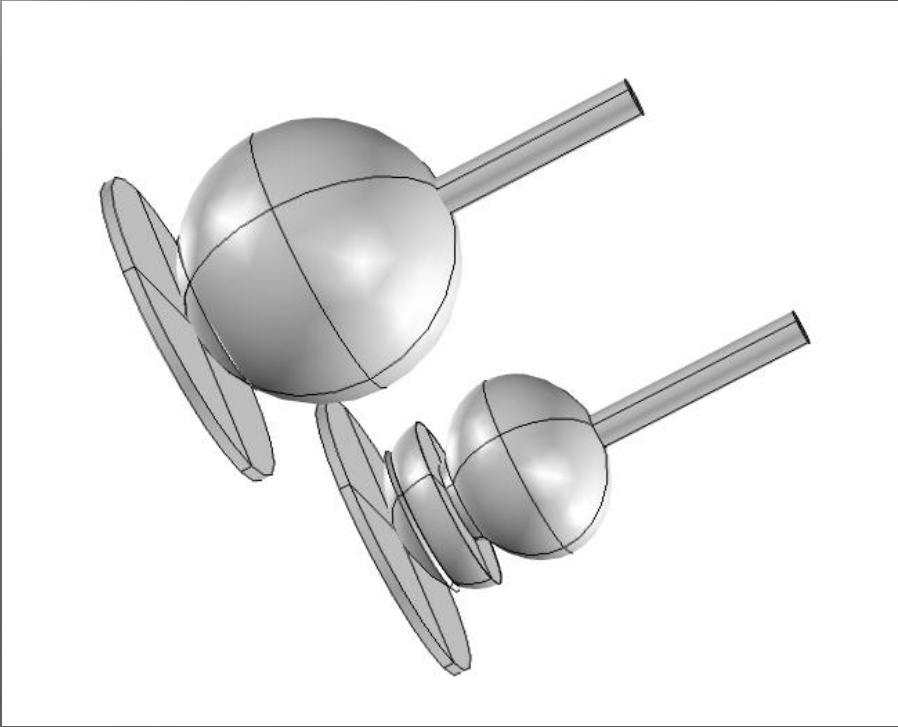
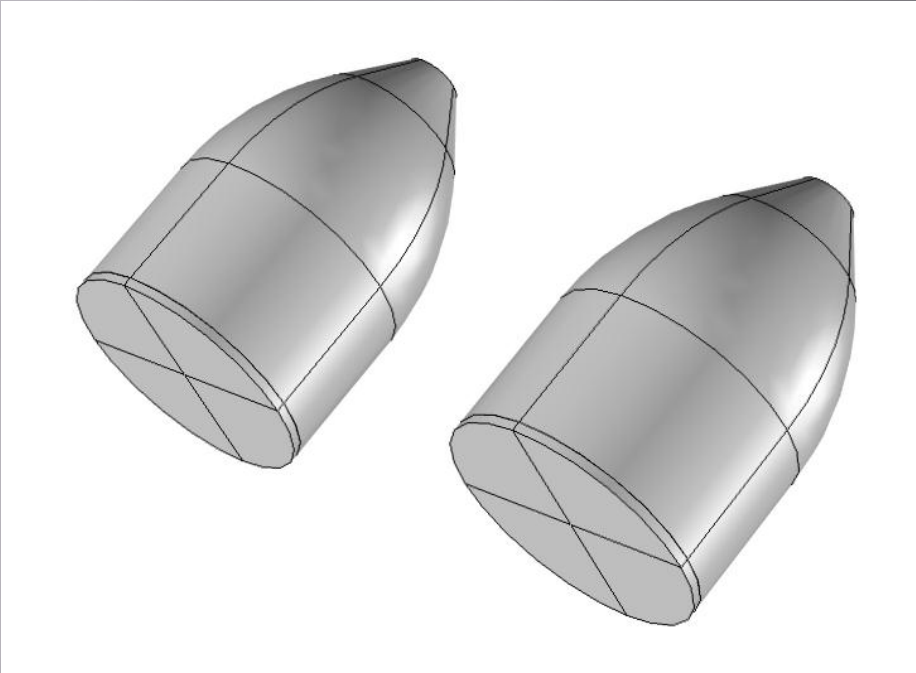
- Convective heat transfer (flat plate?).
- 2D eye geometry rotated  $360^\circ$  to form 3D model.
- Model includes eyeballs, eyeball sockets, brain, brain housing, skull, major sinuses, and face.
- Boundary conditions (initial and neck-torso).

# Table 1: Thermal Properties of Human Tissue

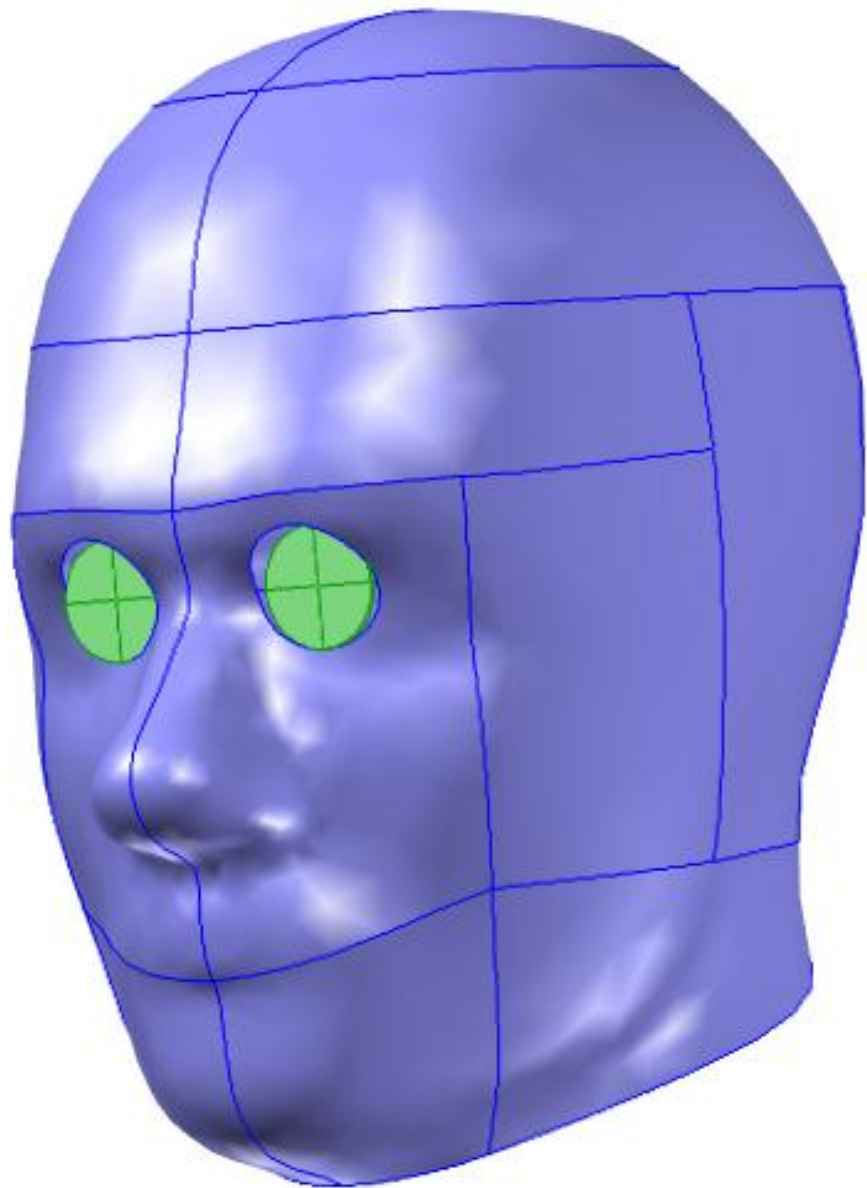
	k	Cp	density
cornea [5]	0.58	4178	1050
aqueous humor [5]	0.58	3997	996
iris [5]	1.004	3180	1100
lens [5]	0.40	3000	1050
vitreous body [5]	0.603	4178	1000
sclera [5]	1.004	3180	1100
Eye fat/ fluid [9]	0.21	2300	920
bone [9]	0.75	1700	1357
brain [9]	0.49	3850	1080
skin [9]	0.47	3680	1085

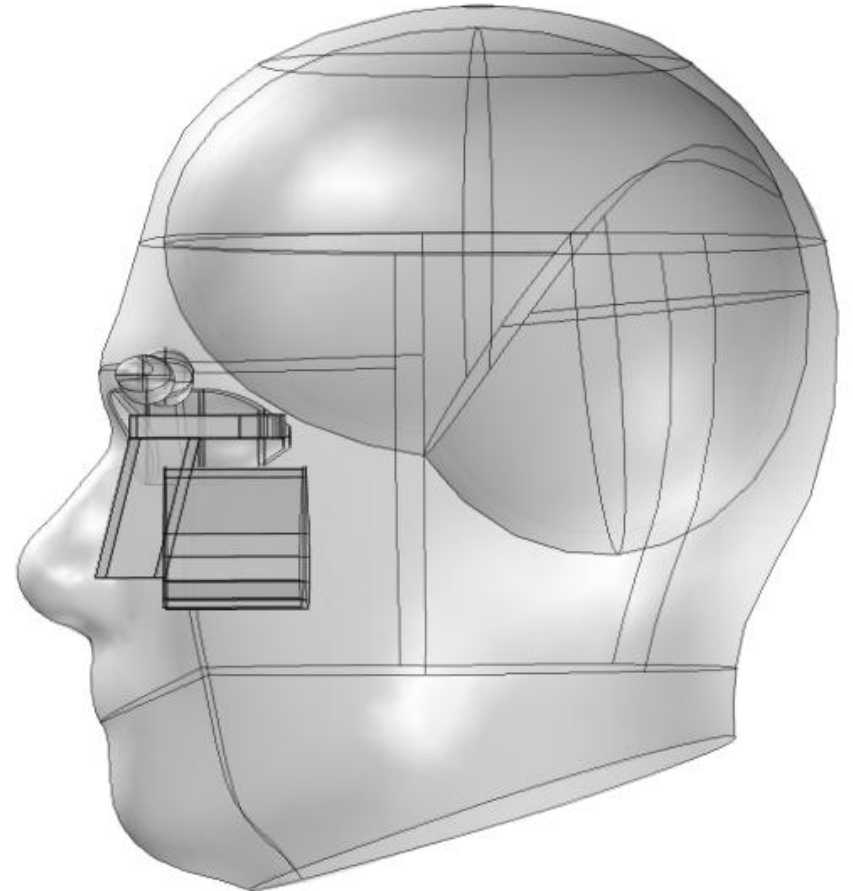
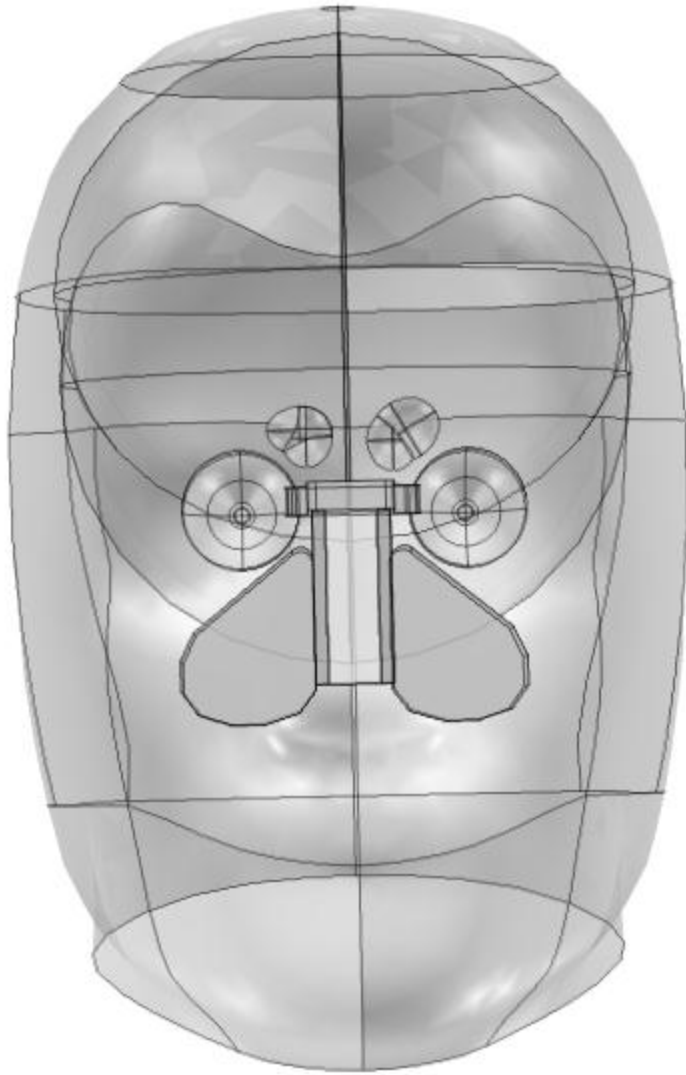


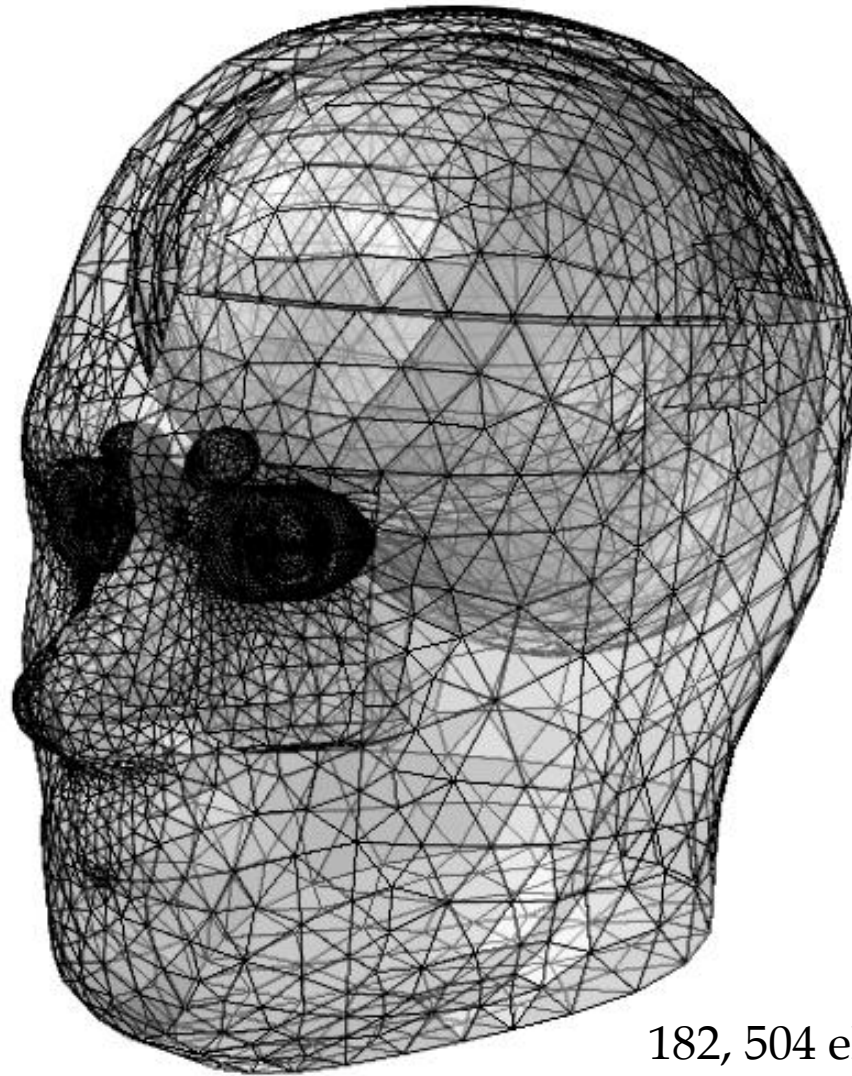
1. Eyelid 2. Bone housing 3. Orbit fat/muscle/fluid 4. Sclera 5. Vitreous humor 6. Lens 7. Aqueous humor 8. Iris 9. Cornea 10. Optic nerve.







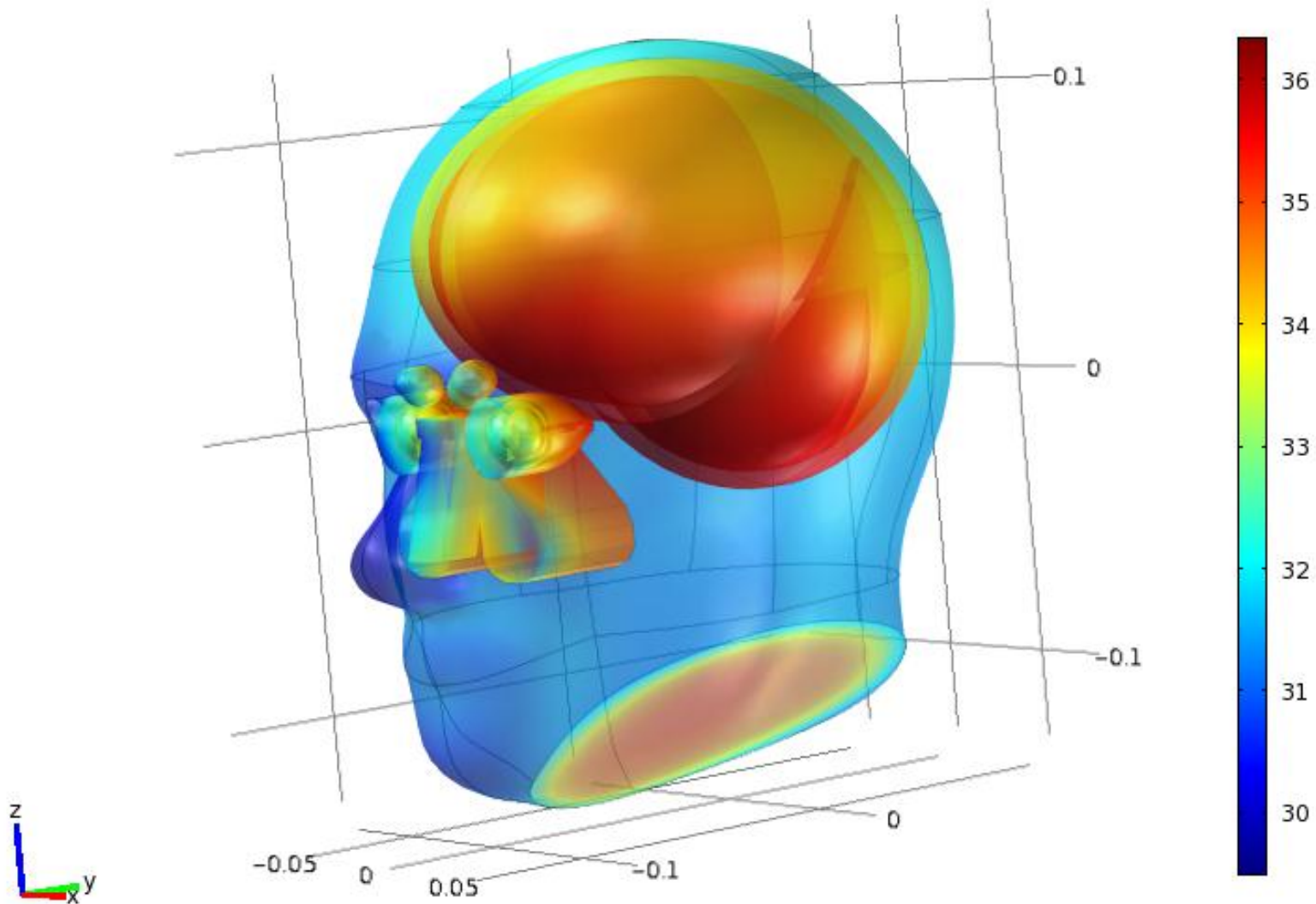




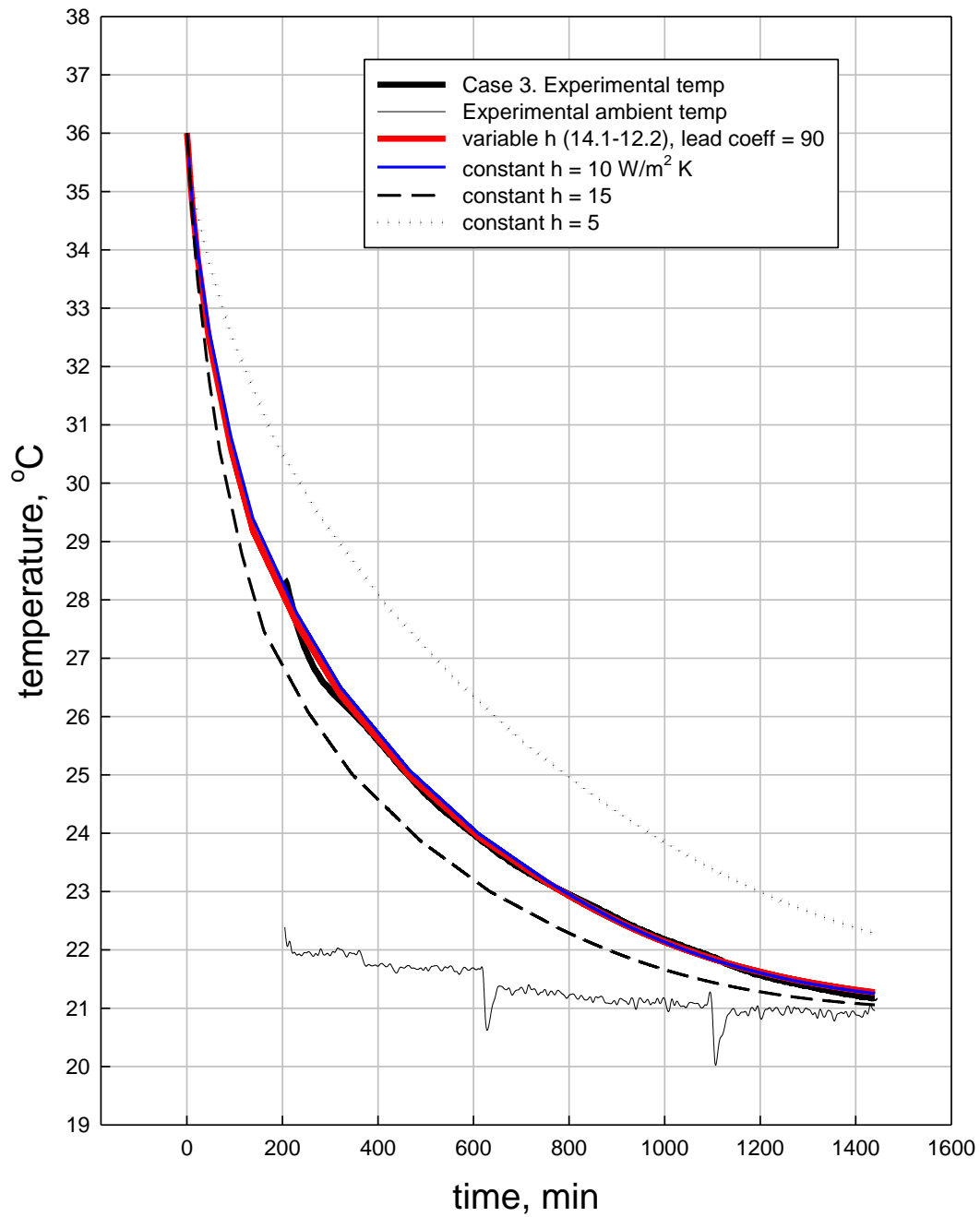
182, 504 elements.  
3.5 -17.5 minutes to execute.

Time=1080 Surface: Temperature (degC)

▲ 36.34



▼ 29.49



# CONCLUSIONS

- Sensitivity analysis.
- Incorporation of additional experimental data.
- Exploration of “temperature plateau” effect.