

102° SIO
Roma 2015

102° Congresso Nazionale

Società Italiana di Otorinolaringologia
e Chirurgia Cervico-Facciale

Roma, 27-30 maggio 2015

Ergife Palace Hotel

Presidente

Giuseppe Spriano

UNA SOCIETÀ NAZIONALE RIVOLTA AL MONDO

102nd SIO
Rome 2015

102nd National Congress

Italian Society of Otorhinolaryngology
Head and Neck Surgery

Rome, 27th-30th May 2015

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AN INTERNATIONALLY ORIENTED SOCIETY

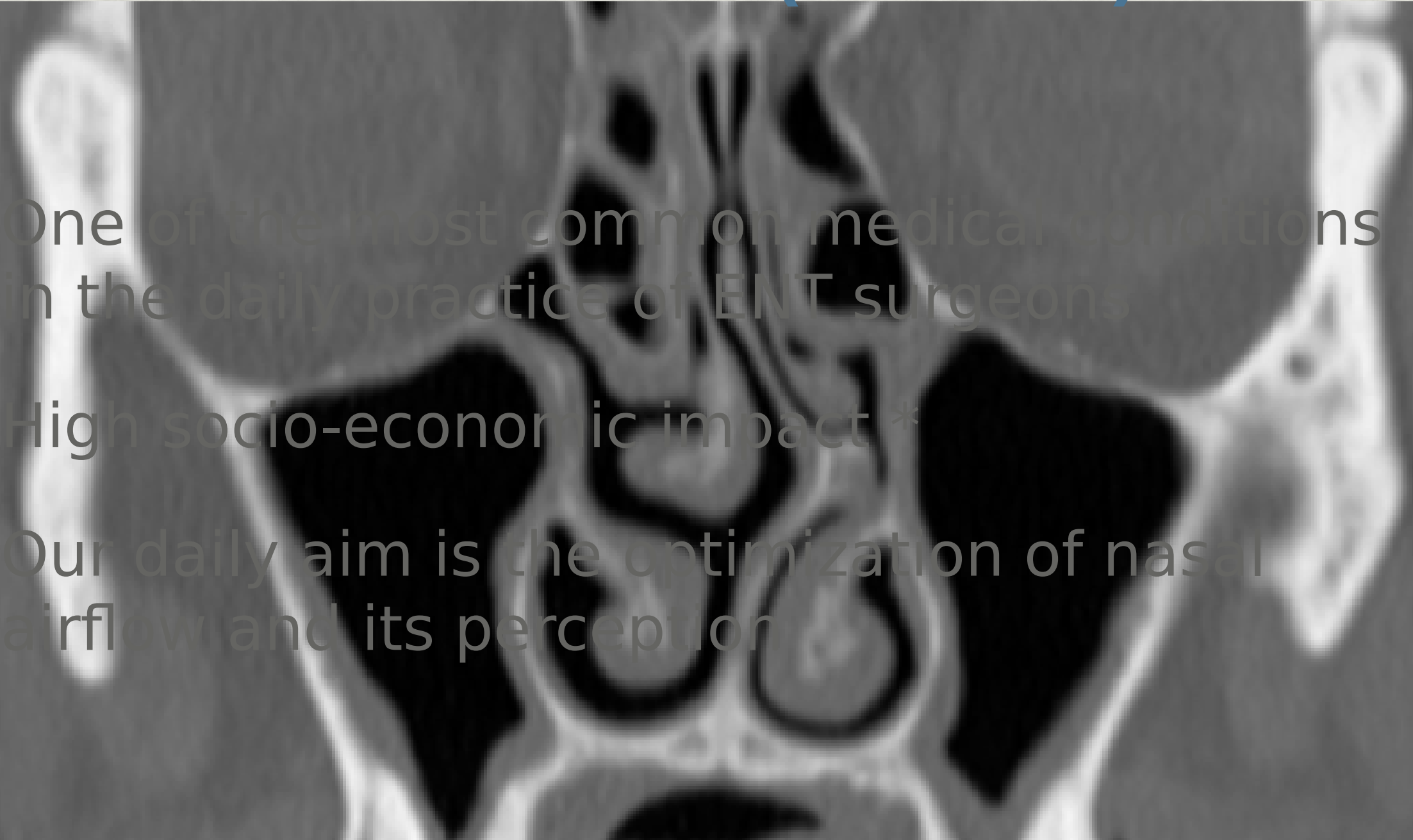
Computational Fluid Dynamics in Nasal Breathing Difficulties: definition of parameters

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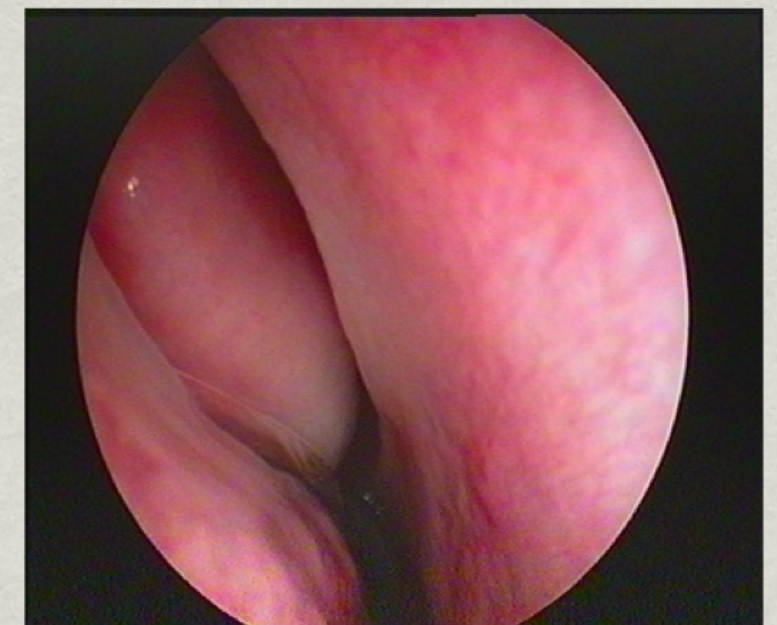
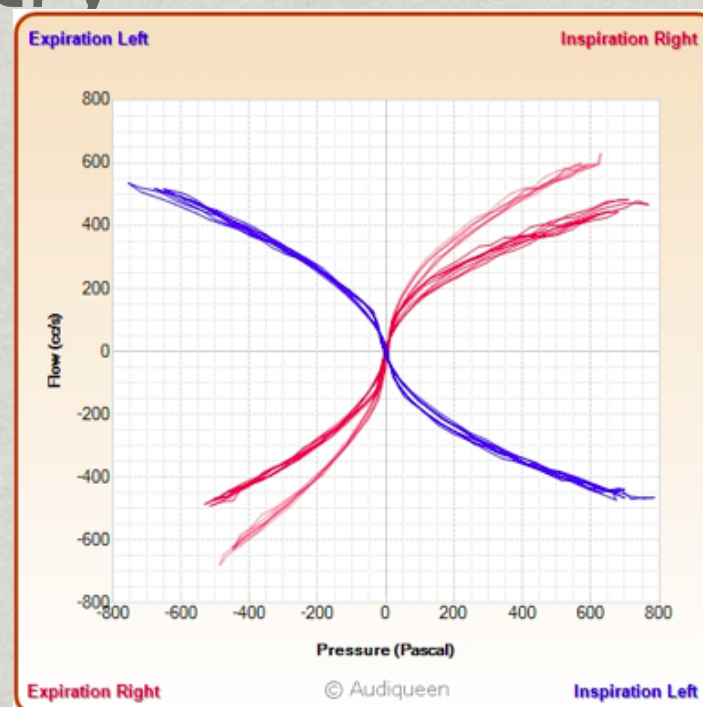
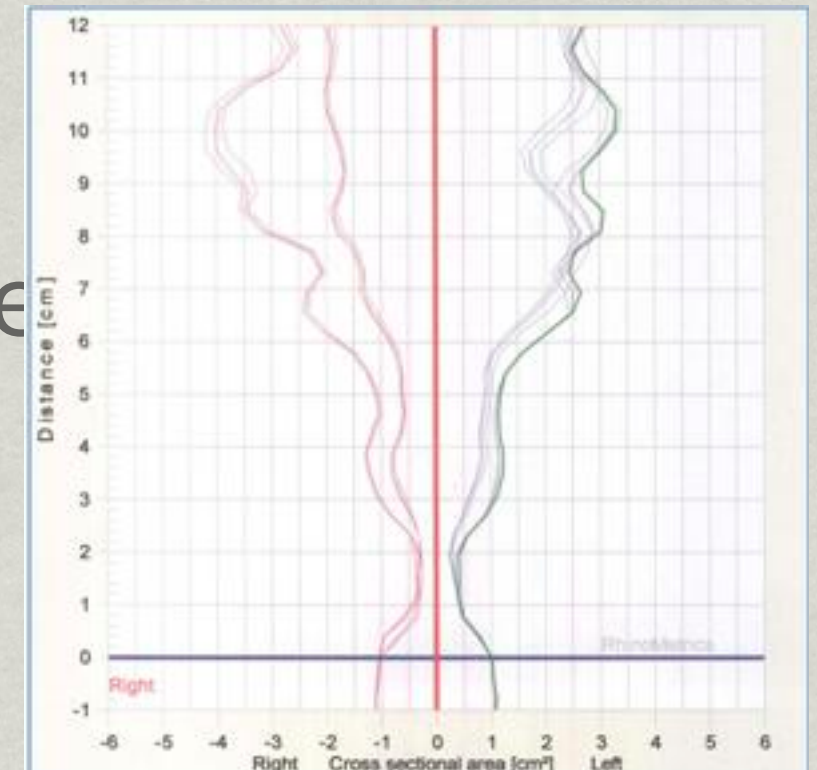
Nasal Breathing Difficulties (NBD)

- 
- An axial CT scan of the human head, focusing on the nasal cavity. The image shows the bony structures of the nasal cavity, including the nasal conchae and the nasal valve. The text is overlaid on this image.
- * One of the most common medical conditions in the daily practice of ENT surgeons
 - * High socio-economic impact *
 - * Our daily aim is the optimization of nasal airflow and its perception

* *Stewart M, Ferguson B, Fromer L (2010) Epidemiology and burden of nasal congestion. Int J General Medicine 3:37- 45*

NBD-Evaluation today

- * Clinical assessment (endoscopy e
- * Rhinomanometry
- * Acoustic rhinometry
- * CT scan



Day to day practice



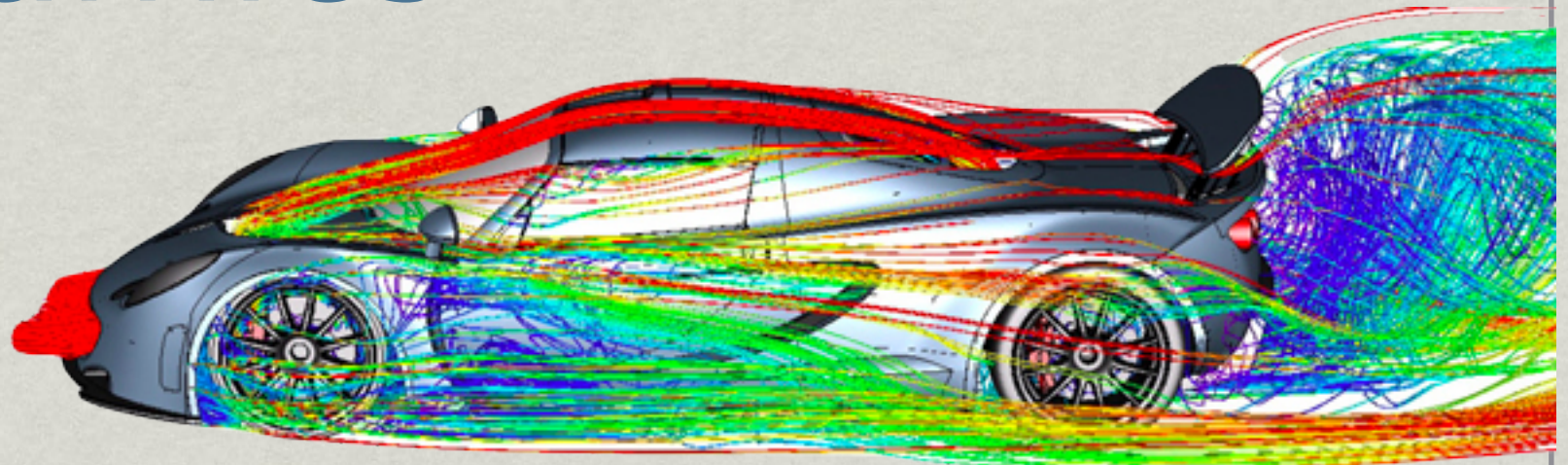
WE HAVE NO METHODS THAT:

- * assess nasal airflow at specific anatomical areas (middle meatus, inferior turbinate etc.)
- * assess the perceived quality of the flow
- * measure the impact of anatomical anomalies on nasal flow and mucosa

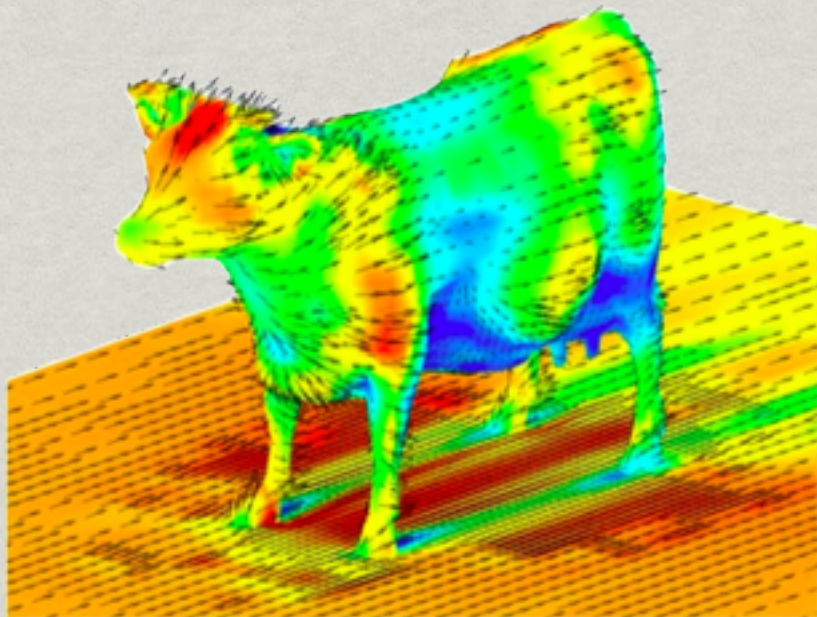
Airflow evaluation- available techniques

- * in vivo: rhinomanometry (only overall data)
- * in vitro: modified Mink boxes (anatomical reconstruction)
- * **Computational fluid dynamics** (virtual reconstruction and simulation)

Computational Fluid Dynamics

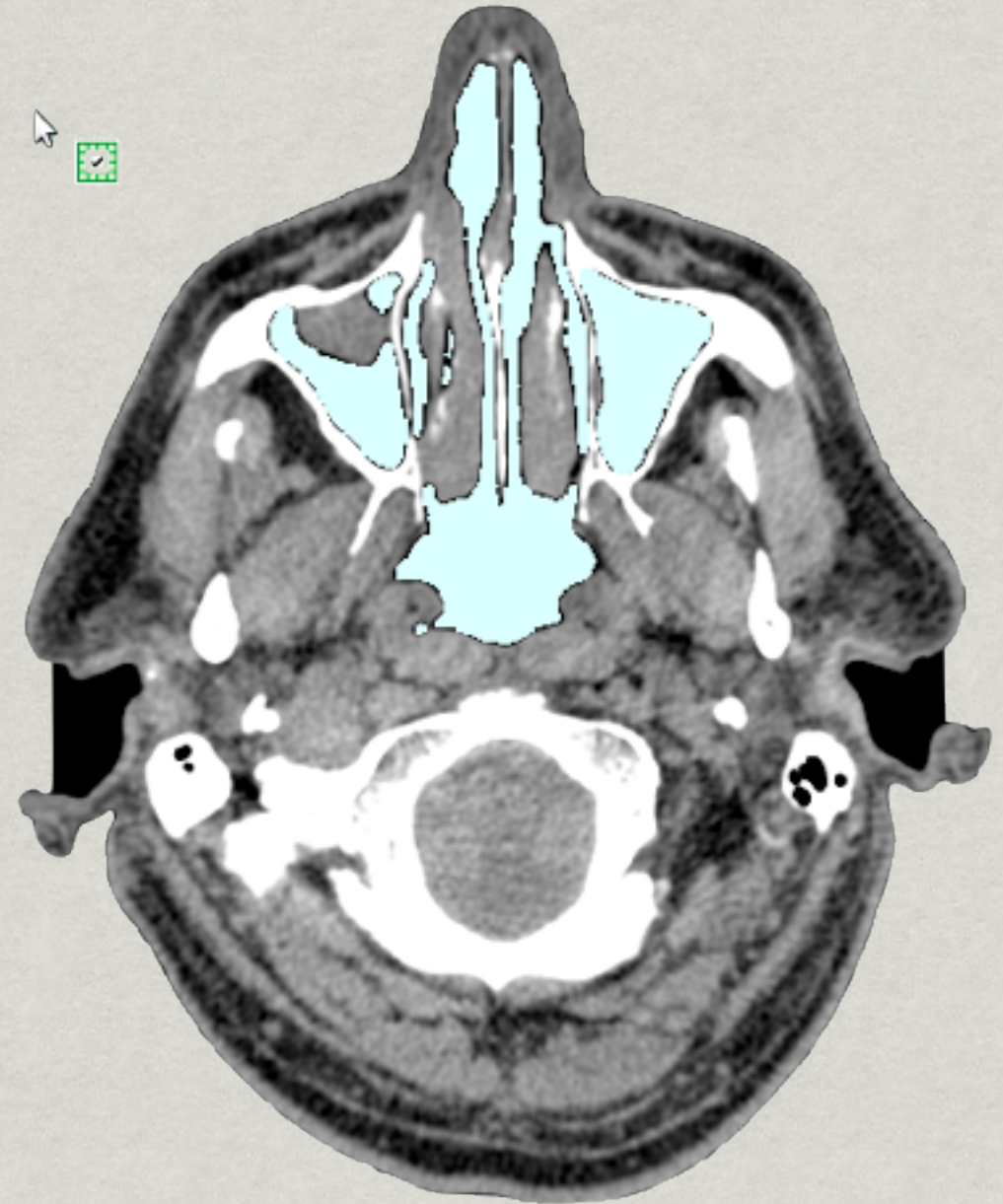


- * Simulation of a flow pattern, shear stress, temperature and humidity exchange

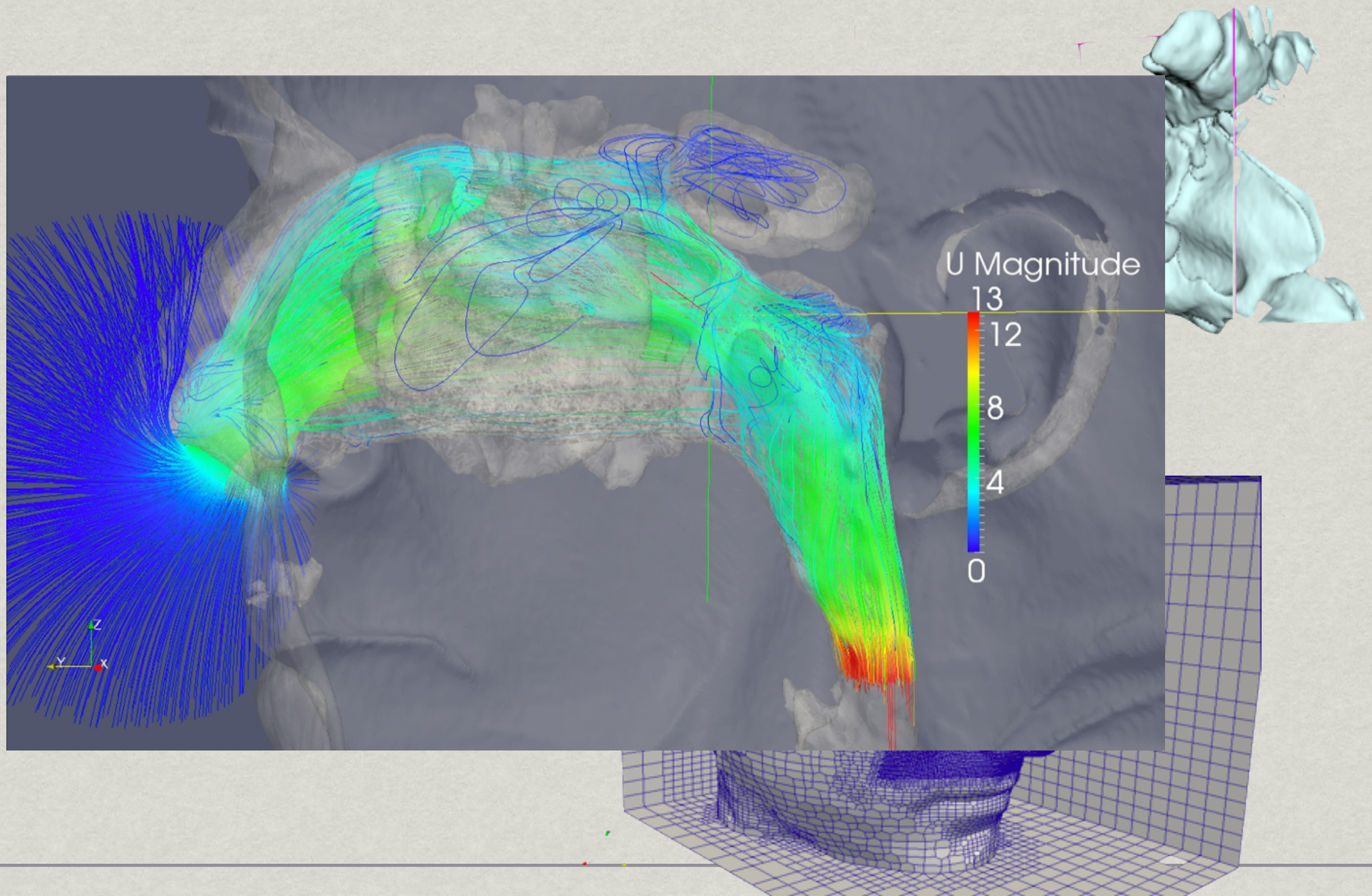


OpenNOSE-Methods

* from CT scan



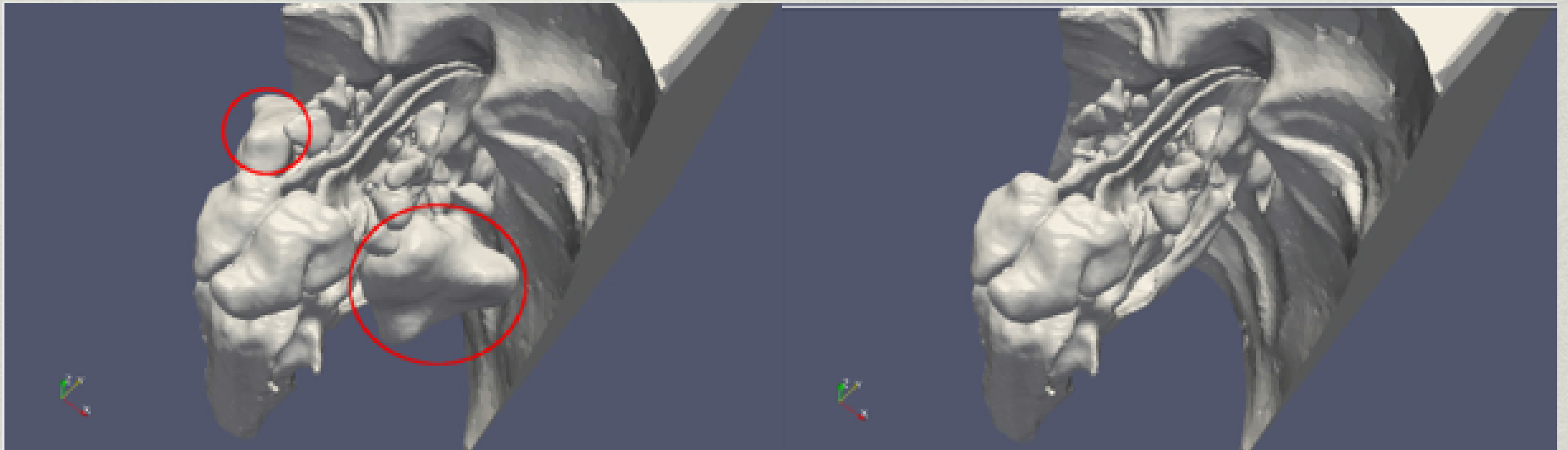
OpenNOSE-Methods



Open questions for viable CFD procedures in clinical practice

- * How the end results are affected by the segmentation threshold used to convert the CT images into a three-dimensional computational volume mesh
- * How the end results are affected by the quality (spatial resolution) of the CT scan

Definition of parameters -Threshold-



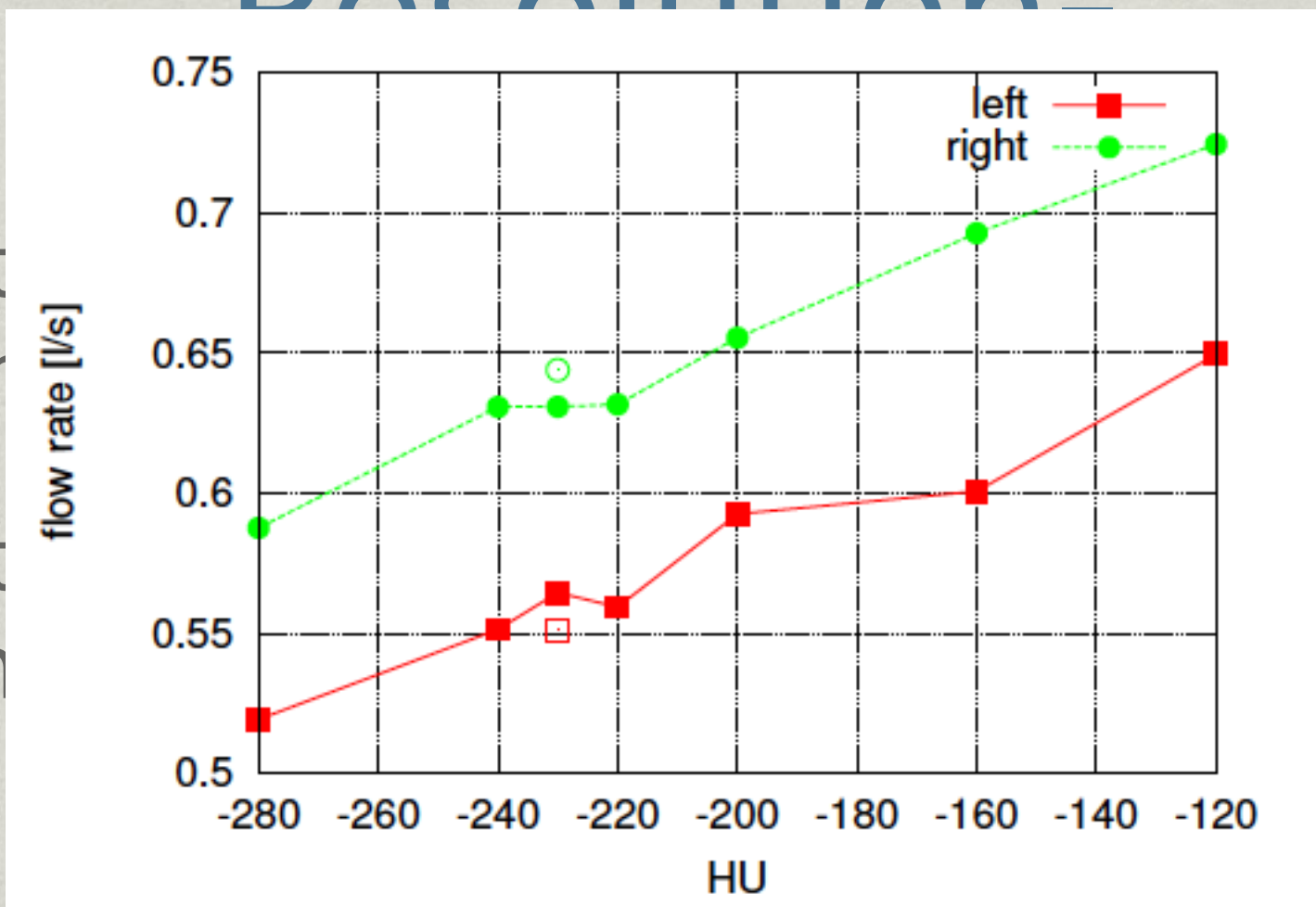
Effect of the radiodensity threshold on the reconstructed geometry. By going from -200 HU to -280 HU, the internal volume becomes progressively reduced, and several volume fractions related to the maxillary sinuses (circled) are excluded.

Definition of parameters

-Adding Spatial Resolution-

Resolution-

- * Reconst 0.625 mm
- * Reconst slices in



ith
.
25 mm

Flow rate (expressed in liters per second) through the right (green curve, circles) and left (red curve, squares) nostrils, as a function of the radiodensity threshold (expressed in HU) employed for the reconstruction of the three-dimensional volume of interest. The plateau between -240 and -220 HU can be appreciated. The open symbols are for the low-quality reconstruction at -230 HU

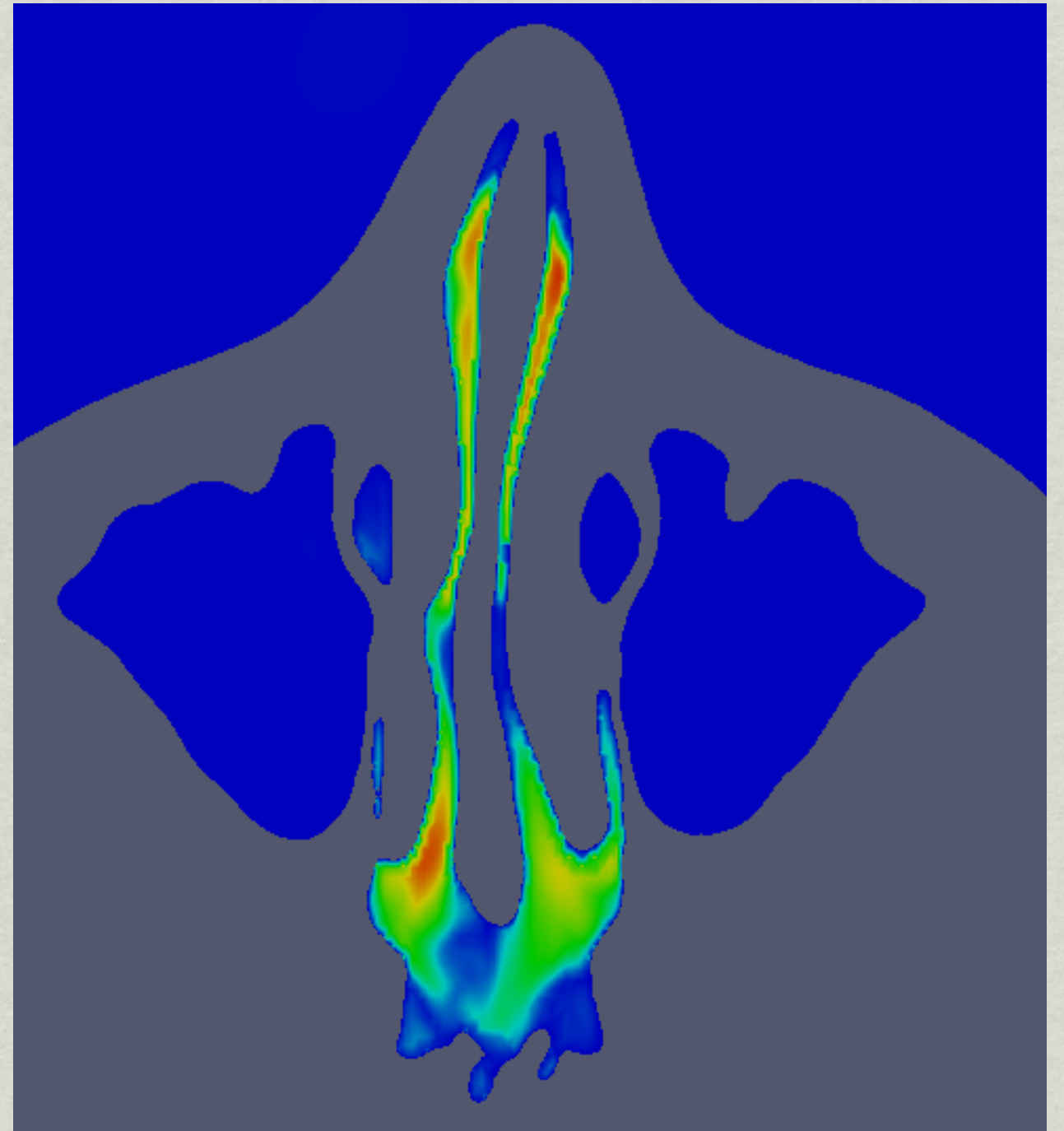
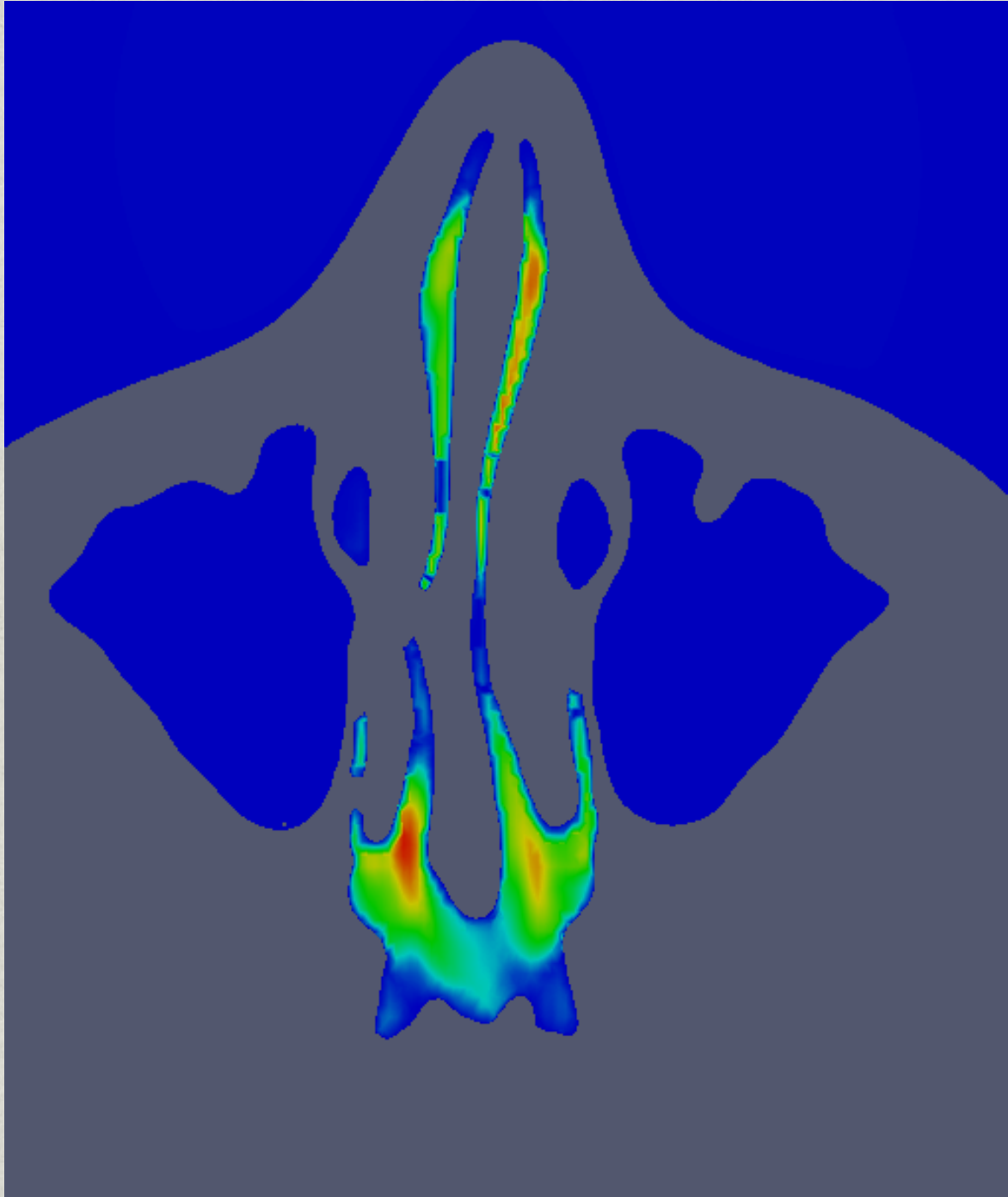
What we currently
do
-The LES Approach-



Virtual Surgery...



Virtual Surgery!



Conclusions

Definition of correct parameters pivotal to:

- * objectify flow anomalies due to anatomical alteration and their impact on nasal mucosa
- * pre-surgical planning and simulation of surgical outcome

Next/Current

- * In vitro validation through silicone models from CT scan and their analysis with *particle image velocimetry (currently operational)*
- * Applying simulation to specific anatomical variations: e.g. septal perforation, olfactory deficits and more
- * Readyng the technology for day to day use



Thanks to...

DEPARTMENT
OF AERONAUTICAL ENGINEERING,
POLITECNICO DI MILANO

Prof Maurizio Quadrio

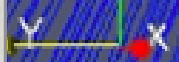
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