

**Doctoral School of Information and Biomedical Technologies
Polish Academy of Sciences (TIB PAN)**

SUBJECT:

Neurosurgical Support System for Craniofacial Access Procedures

SUPERVISOR:

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DESCRIPTION:

Modern neurosurgery makes it possible to treat tumors through complex surgery. For example, the use of craniofacial access to the brain allows for minimizing complications. Surgery planning follows imaging studies such as MRIs and CT scans, however, a complex method requires detailed planning by a specialist. The aim of this study is to facilitate the planning process for the specific type of surgery by proposing suitable modeling tools.

The dissertation will focus on the research for the methods of analysis, development, and implementation of 3D modeling algorithms for medicine. Issues related to reconstruction algorithms in 3D graphics will be covered.

The dissertation will have practical applications in neurosurgical operations. The modeling algorithms will produce better visualizations for surgery planning, including the design of neurosurgical tools. The analysis and research work on modeling algorithms will allow better ideas about whether surgical treatment can be applied and how to perform the procedure. In particular, innovative 3D modeling and planning algorithms will help to improve the quality of treatment and patient comfort in surgeries with transcranial access.

BIBLIOGRAPHY:

1. Straižys, A., Burke, M., Brennan, P.M. *et al*: A generative force model for surgical skill quantification using sensorised instruments. *Communications Engineering*, 2023, Article number 36.
2. Maxime Berar, Françoise M. Tilotta, Joaquin A. Glaunès, Yves Rozenholc. Craniofacial reconstruction as a prediction problem using a Latent Root Regression model. *Forensic Science International*, 2011, Vol. 210, Issues 1-3, Pages 228-236.
3. Hanalioglu Sahin, Romo Nicolas Gonzalez, Mignucci-Jiménez Giancarlo, Tunc Osman, Gurses Muhammet Enes, Abramov Irakliy, Xu Yuan, Sahin Balkan, Isikay Ilkay, Tatar Ilkan, Berker Mustafa, Lawton Michael T., Preul Mark C. Development and Validation of a Novel Methodological Pipeline to Integrate Neuroimaging and Photogrammetry for Immersive 3D Cadaveric Neurosurgical Simulation. *Frontiers in Surgery*, 2022, Vol. 9.

4. Haider Abo Sharkh, Nicholas Makhoul. In-House Surgeon-Led Virtual Surgical Planning for Maxillofacial Reconstruction. *Journal of Oral and Maxillofacial Surgery*, 2020, Vol. 78, Issue 4.
5. Ostaş, Daniel and Almăşan, Oana and Ileşan, Robert R. and Andrei, Vlad and Thieringer, Florian M. and Hedeşiu, Mihaela and Rotar, Horaţiu. Point-of-Care Virtual Surgical Planning and 3D Printing in Oral and Cranio-Maxillofacial Surgery: A Narrative Review. *Journal of Clinical Medicine*, 2022, Vol. 11.
6. Parthasarathy Jayanthi. 3D modeling, custom implants and its future perspectives in craniofacial surgery. *Annals of maxillofacial surgery*, 2014, Vol. 4, Issue 1.