From Concept to Code: Leveraging Vibe Coding and AI to Build MorphoNeuro, a Novel Open-Source Platform for Neurosurgical Research

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Introduction

The creation of specialized neurosurgical tools is often hindered by limited programming expertise, which slows translational research. With the emergence of vibe coding – an Artificial Intelligence (AI)-driven workflow in which natural language prompts generate and refine functional code – clinicians can now directly participate in building software. This study presents MorphoNeuro, a novel open-source three-dimensional (3D) morphometric analysis tool developed entirely through this method using AI assistance and collaborative platforms (Figure 1).

Materials and Methods

We employed AI-assisted coding tools (Cursor 0.45, Anysphere, Inc., San Francisco, CA) to iteratively build and debug Python code and create a Blender (Blender Foundation, Amsterdam, The Netherlands) add-on (Figure 2) using only natural language prompts. Key functionalities, including neuronavigation coordinates importing, automated calculation of morphometric parameters on 3D models (Figure 3) including angles of attack, surgical windows, and exposure volume (Figure 4), and standardized visualization for comparative studies (Figure 4), were generated without requiring formal computer science training. Version control was managed via GitHub, prioritizing a workflow that ensures accessibility and reproducibility for researchers.

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Figure 1. Iterative vibe coding session building features and fixing bugs using natural language prompts.

Figure 2. MorphoNeuro's intuitive interface in Blender allows to construct volumetric models from navigation coordinates or on three-dimensional surface scanning models and analyzing morphometrics automatically.

Results

MorphoNeuro was implemented successfully on Windows, macOS, and Linux operating systems. Testing was completed on 40 unique 3D models of pterional and orbitopterional approaches to internal carotid artery and middle cerebral artery bifurcation (example in Figure 3), which confirmed the seamless construction of volumetric corridors, automatic metric extraction, alongside the importing and comparing of stereotactic coordinates, facilitating anatomical analysis of surgical corridors. Advanced features like automated volumetric surgical corridor reconstruction and batch analysis were integrated through rapid vibe coding iterations (Figure 1). The process demonstrated that AI-assisted coding environments can lower the technical threshold for software creation, allowing surgeons to generate tailored research tools from scratch.

Conclusions

The development of MorphoNeuro highlights how vibe coding, combined with AI assistants and open-source platforms, democratizes software innovation in neurosurgery. By empowering researchers to act as tool creators rather than passive users, this approach accelerates translational research and reduces dependence on commercial or proprietary systems. As the ecosystem of vibe coding tools continues to expand, more clinicians will gain the ability to design, refine, and share novel applications aligned with their research and surgical needs.
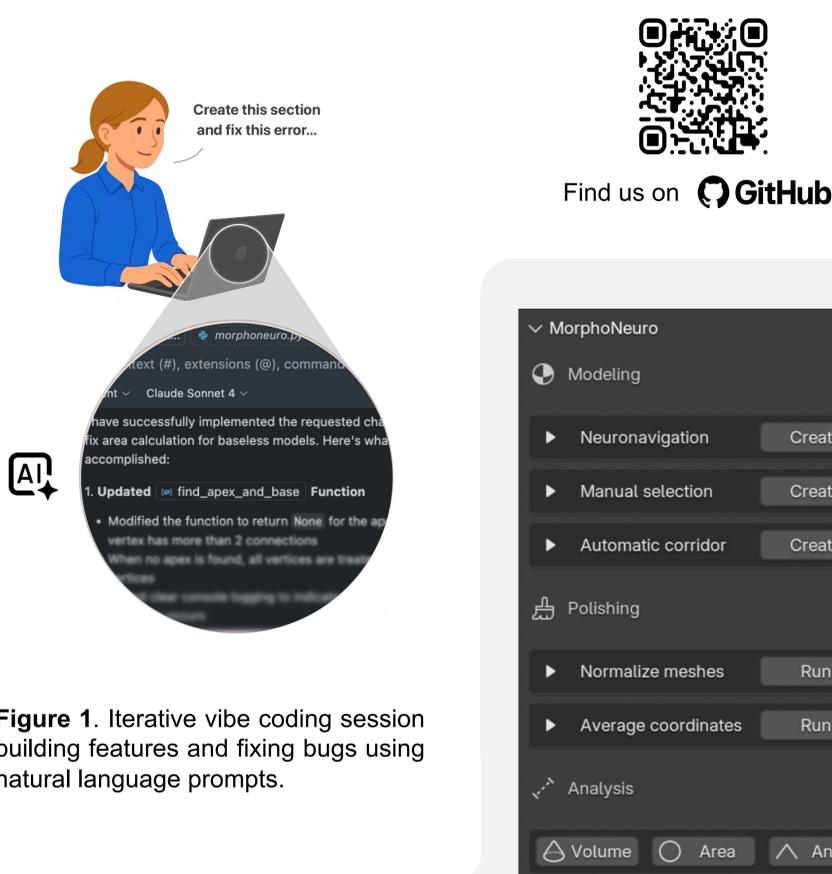

Figure 3. An example of a left orbitopterional approach to the internal carotid artery bifurcation with an overlaid semi-transparent surgical corridor created using MorphoNeuro.
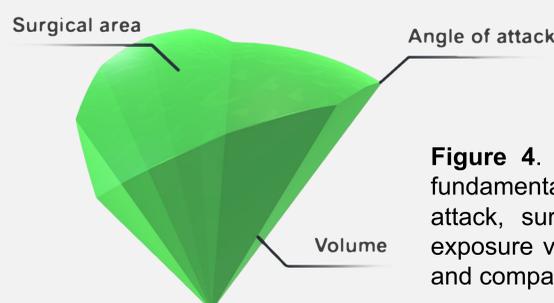

Figure 4. A surgical corridor with the fundamental 3 parameters (angle of attack, surgical area, and normalized exposure volume) that can be analyzed and compared using MorphoNeuro.

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