The motor-assisted robotic stereotaxy system presents a compact and light-weight robotic system for stereotactic neurosurgery. Our system is designed to position probes in the human brain for various applications, for example, deep brain stimulation. It features five fully automated axes. High positioning accuracy is of utmost importance in robotic neurosurgery.

METHODS: First, the key parameters of the robot's kinematics are determined using an optical tracking system. Next, the positioning errors at the center of the arc–which is equivalent to the target position in stereotactic interventions–are investigated using a set of perpendicular cameras. A modeless robot calibration method is introduced and evaluated. To conclude, the application accuracy of the robot is studied in a phantom trial.

RESULTS: We identified the bending of the arc under load as the robot's main error source. A calibration algorithm was implemented to compensate for the deflection of the robot's arc. The mean error after the calibration was 0.26 mm, the 68.27th percentile was 0.32 mm, and the 95.45th was 0.50 mm.

CONCLUSION: The kinematic properties of the robot were measured, and based on the results an appropriate calibration method was derived. With mean errors smaller than currently used mechanical systems, our results show that the robot's accuracy is appropriate for stereotactic interventions [1)].

1)
Heinig M, Hofmann UG, Schlaefer A. Calibration of the motor-assisted robotic stereotaxy system: MARS. Int J Comput Assist Radiol Surg. 2012 Nov;7(6):911-20. doi: 10.1007/s11548-012-0676-7. Epub 2012 Mar 14. PubMed PMID: 22415801.