BOSTON ENGINEERING

University Advances Memory Research with Groundbreaking Precision and Speed

The Back Story

Research at a leading university includes projects to map the brain's neural connections and discover how memory and thought processes are formed. The research requires the precision to slice brain tissue 20 nanometers thin – which is equivalent to slicing a human hair into 4,000 sections by width – and to provide thousands of sections from the same sample quickly. The project team then uses the samples to create 3-D models of the brain's sub-cellular structure for further analysis.

This approach faced significant hurdles because commercially available ultramicrotomes, the instrument used to gather samples, cut slices at least twice as thick as desired for testing. The technology was also slow and manual; even experienced technicians could only create 10-20 samples at one time.

The Strategy

The university turned to Boston Engineering for its precision motor control and automation background, and its integrated mechanical, electrical, and software capabilities. Boston Engineering accelerated project delivery through its process to work on multiple components in parallel. Instrument features include:

System Performance

- Deliver advanced motor control to create the nano-precision samples (two-to-three times thinner than commercially available technologies)
- Control vibrations, temperature changes, and other environmental variables that could negatively impact performance
- Enable the system to run continuously for days or weeks with minimal operator intervention
- Design a flexible architecture that supports feature upgrades with minimal system changes

User Administration

- Operate the system in manual or automated modes using an industrial PC
- Monitor and manage real-time cutting operations using:
  - Data acquisition and control
  - Camera and microscope/optical system
  - Automated alerts

The Impact

Preliminary testing shows that the lab instrument is exceeding university performance benchmarks across key metrics. University officials are evaluating how to align the instrument's powerful capabilities with the school's neuroscience research priorities and funding.