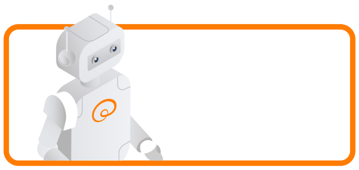

Brain Corp Outlines Scalable Operating Systems in New Research Paper

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Brain Corp

Recognized by IEEE Rototics and more, the paper overviews the parallel algorithm floor sweepers use in precise navigation of retail stores.

An outline of the proven, precise, and safe motion planning methodology used in BrainOS, a cloud-connected operating system for commercial autonomous robots, has been published in the July, 2019 edition of the IEEE Robotics and Automation Society Letters (RA-L) Journal. Peer-reviewed, the IEEE Robotics and Automation Letters (RA-L) Journal publishes innovative application case studies and significant research ideas in robotic automation.

Founded in 2009, the engineering team at Brain Corp had been challenged to create a commercially scalable operating system architecture for autonomous robots that removed computational constraints to enable safe, efficient, robotic operations when operating in cluttered, obstacle-strewn environments. “We developed a low-level algorithm for path and motion planning called the Tensor Dynamic Window Approach (TDWA) which addresses this problem,” states Oleg Sinyavsky, Director of Research and Development at Brain Corp. “The main novelty of TDWA is that its methodology makes the full flexibility of model predictive control available to us. And since TDWA deterministically selects a motion primitive from a predefined set, it runs in constant time.”

By running in constant time, no matter how the local environment is configured, there is no delay with the robots ability to respond in real time – it will stop immediately if no safe motor command is available, a critical commercial advantage for safe motor command selection and smooth navigation.

The paper, titled “Parallel Algorithm for Precise Navigation Using Black-Box Forward Model and Motion Primitives”, outlines the navigation planning architecture the engineering team at Brain Corp developed. By employing this unique architecture, computational constraints for commercial viability are removed, allowing the navigation behavior of the robot to be precisely controlled in real time.

An example of this precise control can be seen when our BrainOS-powered robots immediately stop when unknown, or unrecognized objects suddenly appear in front of them. In situations like this, a human requires a few seconds to think about what to do, whereas a BrainOS powered robot reacts instantly and consistently.

"Our method has several properties that make it well-suited for commercial applications: it is deterministic, computationally efficient, runs in constant time, and can be used on platforms of arbitrary shape and drive type," says Dr. Jean-Baptiste Passot, Vice President, Platform and AI at Brain Corp.

According to the paper, the methods employed by the architectural design use incoming localized information from multiple sensing devices, processed in constant time alongside precomputed costmaps that dictate robotic motion. The key advantage to using a constant time algorithm as opposed to traditional methods is that the robot's reaction time is then very predictable, ensuring that BrainOS powered robots always make the optimal decision on time.

"Compared to traditional Dynamic Window Approach algorithms, which calculate the cost of each command separately, TDWA evaluates the costs of all motion primitives in a single tensor operation, thus speeding up this computation substantially," states Sinyavsky. "This allows finer cost discrimination among a larger set of motion primitives with longer time-horizons, which helps avoid dead-end situations without compromising safety."

This novel approach has resulted in BrainOS-powered robots accumulating an impressive track record since being commercially deployed, with BrainOS powered robots in a variety of form factors boasting 100,000 hours of safe autonomous operations in shopping malls, grocery stores, airports, warehouses and more around the world.

Available for licensing by commercial manufacturers of autonomous robots and mobile equipment, BrainOS works with the de-facto standard for messaging and serialization in robotics applications, Robot Operating System (ROS), enabling those manufacturers the opportunity to leverage existing ROS-enabled projects. BrainOS services are accessible by ROS service calls, actions or message topics, however BrainOS goes above and beyond what ROS is capable of. Additional functionality provided by BrainOS illustrates the scalability of the BrainOS solution. This includes the sensor driver hardware abstraction layer which consists of application-specific firmware and simulation tools, a BrainOS security layer, core middleware libraries, plus other foundational robotic capabilities such as odometry, perception, localization, mapping and motion planning. And that is just what is supplied for baseline robotic functionality.

Brain Corp knows the next step is addressing operations scalability. To jump-start scalability and ensure success, an API framework with user-friendly autonomy, manufacturing, and deployment applications is also furnished, providing our partners with the hard-won knowledge we have learned over the past 10 years. To further empower those partners, BrainOS also comes complete with cloud services for fleet lifecycle management, reporting and more.