Air Force SBIR/STTR

Innovation

Air Force SBIR/STTR Innovation Story

SBIR Topic Number:
AF05-174

SBIR Title:
Creative Mobile Terrain Sensing Multi-Valued Behavior Robots

Contract Number:
FA8651-06-C-0121

SBIR Company Name:
Imagination Engines, Inc., St. Charles, MO

Technical Project Office:
AFRL Munitions Directorate, Eglin AFB, FL

This Air Force SBIR/STTR Innovation Story is an example of Air Force supported SBIR/STTR technology that met topic requirements and has outstanding potential for Air Force and DoD.

Creative Robots ANN Design Library (CRADL)-based control system guides levitated air sled toward totally autonomous rendezvous and docking with its target

Improved Robotic Control System Development Processes

- The Air Force needs creative terrain sensing and multi-valued behavior fusion algorithms for mobile autonomous robots
- Imagination Engines, Inc. (IEI) developed a graphical programming tool in LabVIEW that allows the rapid development and refinement of robotic control systems based upon the company's extensive patent suite
- In the course of this SBIR project, the feed forward speed of these neural network objects has been increased by as much as a factor of ten through the use of General Purpose Graphical Programming Units (GPGPUs)
- IEI has been able to successfully demonstrate autonomous rendezvous and docking for NASA, as well as autonomous trailering wherein one robot automatically locates, hitches with, and then tows another passive vehicle away

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Air Force Requirement

The Air Force needs creative terrain sensing and multi-valued behavior fusion algorithms for mobile autonomous robots. Due to the highly uncertain complex battlefield environments, autonomous mobile robots will have to employ creative behaviors to accomplish their objectives. Autonomous robot navigation in different terrains will require a variety of locomotion techniques.

SBIR Technology

Imagination Engines, Inc. (IEI) developed a graphical programming tool in Laboratory Virtual Instrumentation Engineering Workbench (LabVIEW) that allows the rapid development and refinement of robotic control systems based upon the company's extensive patent suite. At the core of this tool, called Creative Robots ANN Design Library (CRADL), is the fastest and largest personal computer (PC)-based neural network ever created, IEI's patented Self-Training Artificial Neural Network Object (STANNO).

In the course of this SBIR project, the feed forward speed of these neural network objects has been increased by as much as a factor of ten through the use of General Purpose Graphical Programming Units (GPGPUs). Such GPGPUs will ultimately serve as an embedded target to run the IEI neural paradigms aboard both autonomous and semi-autonomous weapons systems. Using both of these new tools, IEI has been able to successfully demonstrate autonomous rendezvous and docking for NASA, as well as autonomous trailering wherein one robot automatically locates, hitches with, and then tows another passive vehicle away.

Potential Air Force Application

The foundation of this SBIR technology is a scientific principle at least as important and fundamental as jet propulsion or nuclear energy – that the injection of critical levels of noise into a system of brainstorming neural networks produces new ideas and strategies. This so-called "Creativity Machine Paradigm" vastly outperforms genetic algorithms running on supercomputers, carrying out multi-million dimensional optimization, invention, and discovery on computational platforms common to most homes and offices. This technology can potentially permeate all aspects of Air Force activities and operations, from materials discovery, to brilliant, autonomous weapons, to logistical planning, to sensor integration. Moreover, this has been described as artificial intelligence's (AI's) best bet in creating human to trans-human level intelligence in machines.

IEI has been the pioneer in developing neural control systems capable of brilliant adaptation and improvisational creativity that may be used to govern truly autonomous weapons systems. The technology also allows semi-autonomous military systems to perform in the event of communications loss, or to temporarily gain a clear advantage by operating outside an adversary's largely human-based Observe, Orient, Decide, and Act (OODA) loop. The technology further allows vast neural systems to automatically knit themselves into the equivalent of human brain pathways that allow unprecedented levels of sensor integration and unexcelled machine vision based anomaly detection (i.e., Battle Damage Assessment or BDA) and classification (i.e., Automatic Target Recognition or ATR).

Company Impact

Dr. Stephen Thaler, President and CEO of IEI, states, "The development of a graphical programming environment for patented IEI systems has been a windfall for the company, allowing us to rapidly prototype and perfect new products and services for varied commercial and governmental customers. Most importantly, it has allowed us to rapidly reduce to practice new patentable concepts underlying various IEI 'carve-out' ventures with other companies and investors. Furthermore, our SBIR efforts in GPGPU-based neurocomputing have provided the basis for harnessing our AI paradigms on embedded targets."

U.S. AIR FORCE

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