Application of Knowledge Enhanced Electronic Logic (KEEL®) Technology for Forensic Analysis Software Tools for Exploitation and Reasoning (FASTER)

Compsim White Paper

Objective:

The intent of this paper is to discuss the potential of Compsim's Knowledge Enhanced Electronic Logic (KEEL®) Technology as a primary information fusion technology that can be used to "discover adversarial behavior within persistent surveillance data". Using KEEL's ability to model human behavior and how that behavior is stimulated by events and scenarios, appropriate responses will be evaluated, recommended, and potentially controlled. The real-time support provided by KEEL Technology and the small memory footprint of packaged KEEL cognitive engines will make KEEL-based solutions suitable for deployment in devices like the AF Distributed Common Ground Station (DCGS-AF), the Aerospace Operation Center (AOC) Weapon System, the National Intelligence Exploitation Capabilities (IEC) environment, the Army and Navy DCGS-A and DCGS-N systems, and other distributed sensor networks that will be required to operate autonomously or semi-autonomously.

Since KEEL Technology is platform and architecture independent it can co-exist with other more conventional approaches. In this manner KEEL cognitive engines can accept information from other sources (sensors, database, synthesized knowledge, or humans, etc). KEEL cognitive engines can also drive other information collectors or control systems. Since KEEL Technology is architecture neutral, it can operate autonomously in individual devices, or it can be distributed across the web.

Technical Summary:

Compsim (Brookfield, Wisconsin) has created a new technology called Knowledge Enhanced Electronic Logic (KEEL®) that allows one to capture, design, test, deploy and audit human-like reasoning or judgmental decision-making for software applications and embedded devices. We call KEEL a “technology”, rather than a software tool, because it includes a new way to process information. The KEEL “dynamic graphical language” has also been described as a new form of mathematics; one where functional relationships are completely defined graphically. The simplicity of this approach allows a domain expert (not necessarily a mathematician or software engineer) to create, test, deploy and audit complex cognitive models. The “dynamic graphical language”, allows a domain expert to “see the system think”, or “interpret information and balance inter-related alternatives” while the algorithmic cognitive models are being created. The KEEL “engines” are the functions or class methods that process the cognitive algorithms (depending on the target computer language selected).

KEEL can also be used in intelligent control systems: where the problem set includes dynamic, non-linear, inter-related, and multi-dimensional information items. KEEL creates an explicit solution. By explicit, we mean that it equates to a formula that can be completely explained and audited. It is an "expert system" in that it requires a human expert to create the models.

KEEL is not Artificial Neural-Net (ANN), Fuzzy, Bayesian, “conventional” Rule-Based or “conventional” mathematics based, although it can easily co-exist with these solutions when appropriate. KEEL is architecture and platform independent. The small memory footprint makes the technology suitable for embedded devices.

Guidelines for FASTER Solutions Satisfied with KEEL Technology:

- **A methodology must be provided that allows the domain expert to define information fusion algorithms with sufficient granularity so that they can be exactly translated into a form that can be explicitly executed by a device or software application.**
- **The methodology for describing the information fusion algorithms must support the efficient development of complex, non-linear scenarios.**
- **The execution engine for the device or software application that will execute the information fusion algorithm must be suitable for embedded real-time operation.**
- **The methodology must be completely understandable so it can be efficiently tested before deployment.**
- **Device or software application performance needs to be audited after deployment.**
- **The efficiency of the entire information fusion algorithm life cycle must be considered (design, test, deploy, audit, extend).**
- **The methodology must be architecture independent so it can be deployed on a variety of platforms and in a variety of situations.**

Compsim will deliver a set of KEEL tools to access the technology (for evaluation only) for a six month period that will allow it to be tested against a wide variety of information fusion problems (Evaluation license). Compsim will train AFRL personnel on the use of the tools. KEEL cognitive engines created by the KEEL Toolkit will be available to be tested in any number of simulation and emulation environments

during the evaluation period. Compsim will work with AFRL to develop demonstration algorithms.

KEEL Technology can be considered Technology Readiness Level (TRL) 4-5.

Compsim / KEEL Technology Background:

Compsim invented KEEL technology and developed all of the supporting software and system engineering tools as a refinement to a human decision-making model where humans make subjective, judgmental decisions that required them to interpret information and balance alternatives. The developers of KEEL Technology have engineering development backgrounds in inertial guidance, aircraft simulation, communication system, industrial robotics, intelligent sensing systems, industrial automation system architectures and interoperability techniques. Demonstrations of KEEL technology have targeted military, medical, industrial automation, financial, automotive, and electronic gaming fields.

Compsim has produced numerous technical papers, application notes and demonstrations of KEEL Technology, many of which are available on Compsim's website. KEEL papers have been presented at several technical conferences including the Phoenix Challenge, Sandia Laboratory Cognitive Conference, ISA, and IEEE High Assurance Systems Engineering Conference and at CITSA 2007 (International Conference on Cybernetics and Information Technologies, Systems and Applications) where it received a "best paper" award.

Openness of Solution

Compsim holds US patents to KEEL Technology. KEEL Technology could be licensed by the government and delivered as Government-Off-The-Shelf (GOTS) technology.

This proposal is also being marketed to selective military and commercial suppliers as potential exclusive licensees. Should they exclusively license this technology they would be the only organizations that could supply this technology.

Compsim LLC is a technology company providing next generation cognitive technology for application in military, medical, transportation, industrial automation, governmental / business, and electronic gaming markets. Compsim licenses its KEEL® technology for use in embedded devices, software applications and for the Internet. The website is: http://www.compsim.com.

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