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13. SUPPLEMENTARY NOTES

14. ABSTRACT

We have built the NYU ATR Laboratory, also known as the RLAB, a computational laboratory for research and education in Automatic Target Recognition (ATR). The laboratory contains a cluster of workstations connected by a fast network, significant data storage capabilities for storing image data, and projection and presentation devices for supporting education and meetings. This facility is accessible via the Internet and is serving as a national resource for ATR researchers.

The laboratory has supported several DoD-sponsored research efforts, being used as a computational resource and as a location for scientific meetings and collaboration. In addition, the laboratory hosted a DARPA-funded training course in experimentation with model-based ATR using the MSTAR system. The laboratory has fulfilled and will continue to fulfill its stated mission of supporting research, development, evaluation, and education in Automatic Target Recognition.

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A Computational Laboratory for Automatic Target Recognition

Final Report

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1. Objectives

We have built the NYU ATR Laboratory, also known as the *RLAB*, a computational laboratory for research and education in Automatic Target Recognition (ATR). The laboratory contains:

- A cluster of workstations connected by a fast network,
- significant data storage capabilities for storing image data, and
- projection and presentation devices for supporting education and meetings. This facility is accessible via the Internet and is serving as a national resource for ATR researchers.

The laboratory has supported several DoD-sponsored research efforts, being used as a computational resource and as a location for scientific meetings and collaboration. In addition, the laboratory hosted a DARPA-funded training course in experimentation with model-based ATR using the MSTAR system.

The laboratory has fulfilled and will continue to fulfill its stated mission of supporting research, development, evaluation, and education in Automatic Target Recognition.

2. Accomplishments

The RLAB has played a key role in fulfilling the computational needs of the following DoD funded ATR efforts;

- The DARPA MSTAR (Moving and Stationary Target Acquisition and Recognition) effort, GRANT # F33615-95-C-1644.

  MSTAR was a DARPA-supported research project charged with the development of a software system capable of reliably identifying targets in synthetic aperture radar (SAR) imagery. Like other model-based ATR systems, the MSTAR algorithm utilized closed-loop iterative refinement to select target hypotheses. The complexity of this large experimental software system increased the difficulty of debugging, evaluation, and tuning.

  Engineering meetings of MSTAR principal investigators and technical leads, were held at the RLAB. The laboratory provided an ideal facility for these meetings, referred to as ''hootenannies", where each participant sat at a workstation in order to

evaluate the system, and was connected to the Internet in order to facilitate collaboration with staff at their home site.

The RLAB benefited the MSTAR algorithmic development efforts in two ways. The availability of the ATR laboratory's network of computers via the Internet benefited MSTAR researchers both at NYU and elsewhere by reducing the time required to evaluate the system. To further facilitate experimentation, the full MSTAR data collection was available on-line at all times. Second, since the ATR laboratory's computers are be equipped with displays and keyboards situated at tables in a large open room with several meeting-rooms nearby, it provided an ideal meeting place for MSTAR hootenannies.

The MSTAR program included compute-intensive evaluation cycles, which were supported by computers at the RLAB. Computational performance on the RLAB's network of linux PCs proved comparable to the high-cost engineering workstations utilized by the other MSTAR participants.

- The DARPA MEP (MSTAR Extension Program) Area 4 effort entitled "Model-based Reasoning in a Distributed Computing Environment", GRANT #F33615-99-C-1506.

  The distributed MSTAR Extension Program is charged with developing enhancements to improve DoD's Semi-Automated INIMIT Processing (SAIP) system. The current focus of this work is in the detection and identification of partially occluded targets while maintaining low false alarm rates. In addition, this effort will provide support for the transitioning of enhanced ATR capabilities into the SAIP system.

  The RLAB has hosted several design/engineering meetings for the effort and is configured to support the anticipated massive computational requirements for evaluation of algorithms being developed by this project. The RLAB has also served as a communications center, using the laboratory's secure web server and email broadcast capability. Recently, the RLAB's portable computers were transported to another facility where they were networked to support the computational needs of an MEP engineering meeting at that site.

- An AFRL-sponsored Small Business Technology Transfer Program effort entitled "Analysis of ATR Problem Complexity and Scalability", GRANT #F33615-99-C-1509.

  An important problem in the analysis of ATR systems is quantifying the growth of algorithm requirements, such as storage and processing costs, as the input problem size expands. This effort is developing a metric of ATR problem size that is akin to input complexity of traditional algorithmic analysis. The measure will provide a numerical assessment of ATR problem complexity that logically orders ATR problems by intrinsic difficult and is tractable to compute.

  This distributed effort has required substantial computational resources. The laboratory computers are heavily utilized to support the evaluation of proposed metrics. In addition, this project utilizes the RLAB's secure web server to facilitate communication between team members.

3. Conclusions

The RLAB has shown that the existence of a facility providing networked computational resources and infrastructure for collaboration is invaluable in supporting intensive

research and development in ATR. In addition, these resources are critical for supporting distributed research efforts.

4. Personnel Supported

- Josh Fishman, system configuration consultant
- Mariam Argyle, system configuration consultant
- Angel Aponte, system configuration consultant

5. Technical Publications

"MSTAR's Extensible Search Engine and Model-Based Inferencing Toolkit", J. Diemunsch, J. Wissinger, W. Severson, and E. Freudenthal. Proceedings of SPIE Symposium on Algorithms for Synthetic Aperture Radar Imagery, 1999.

6. Interactions/Transitions

- Computational and meeting support for three distributed DoD-funded research projects.
- Host of MSTAR training program on experimentation in SAR ATR.

7. Patent Disclosures

None.