The emerging discipline of network science examines the interconnections among diverse physical and engineered networks.

At the University of Maryland, researchers are making significant contributions to this interdisciplinary field, developing algorithms and tools to advance network behavior. Their work involves the very latest network technologies, including information networks, social networks, biological networks, sensor networks and communication networks.
In the age of electronic information overload, V.S. Subrahmanian, who directs the University of Maryland Institute for Advanced Computer Studies, has developed software that retrieves information from millions of newspaper articles and other open source materials on the Web in semi-real time. STORy, a system that tracks a vast amount of materials for years, can be used to provide a division of the U.S. Army with information regarding the history, politics and culture of several Afghan tribal groups before the division’s deployment to Afghanistan. The research team is also developing algorithms to model and predict future behavior, such as how such warring tribes are likely to behave under particular sets of circumstances.

The OASYS system looks at a collection of documents (in multiple languages) and assigns an “imprint” of opinion of a given document on a given topic. Based on a series of complex algorithms, the OASYS technology is capable of tracking the media on the Internet in many languages, measuring worldwide opinion on a variety of subjects.

A software platform called GD-STAR (Global Disease Surveillance Tracking and Analysis Repository) gathers information about diseases occurring around the world and tracks them in real-time to provide alerts to relevant public health officials well before a widespread outbreak occurs. The RBF Detector (T-REX for short) is a development at the Laboratory for Computational Cultural Dynamics, which uses user systems specific to analyze and identify diseases that are spreading rapidly around the world. The RBF Detector uses a technique called heat kernel, which is a kernel of the heat equation on a manifold, to identify geographically distant clusters of disease activity.

BIOLOGICAL | NETWORKS

Through his work in the Center for Bioinformatics and Computational Biology, Computer Science Assistant Professor Carl Kingsford and his team are designing graph algorithms to gain information from biological data. Recently developed high-throughput technologies that use protein-protein interactions from many organisms, creating a wealth of data that must be analyzed computationally. The team is developing graph algorithms and a suite of software tools to extract meaningful biological clusters from incomplete interaction data. This new software will expand the capabilities of biologists working on particular protein complexes and pathways to make better use of network data.

In related work, through a computational search of all available sequences of the surface proteins of the H1N1 virus, their team has found that a similar strain of the virus appeared in Thailand in 2000. This data collection shows that this strain has occurred at least twice in the past ten years and that all previous such sequence re-arrangements were collected in Thailand, which produced more documented human infection.

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COMUNICATION | NETWORKS

John Baras, Lockheed Martin Chair in systems engineering and founder of the Institute for Systems Research, is exploring a number of ways to strengthen the security of broadband wireless communication networks. In collaboration with the Army Research Laboratory, Baras and his team have developed a key exchange system that holds the promise of delivering strongly-secure keys. Baras’ work also focuses on how to build trust in communication networks. His team is using mathematical analysis to understand and predict the emergent behaviors of distributed trust management systems in autonomous networks and to explore how trust is a catalyst for collaboration.

Baras is also leading a Multidisciplinary University Research Initiative (MURI), a multi-agency Department of Defense program, to address fundamental questions about the role that time-scales, network dynamics, and correlations play on the performance and security of military communication networks.

The University of Maryland is home to North America’s first, and the world’s second, laboratory endorsed by the WiMAX Forum and dedicated to creating applications for WiMAX, a next-generation technology for the Web and other wireless communication networks. Computer Science Professor and Director of the Maryland Information Network Dynamics (MINED) Lab Ashish Agrawala is developing a new social networking WiMAX application for cell phones and PDAs. The Myekyll prototype, created for University of Maryland students, will provide a Wi-Fi position on campus within about 10 feet and integrate data with maps, campus construction and transportation updates as well as other information. Agrawala is also developing YY1, a public safety application for a smartphone.