Human Dynamics: Guest Editor's Introduction

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In Sidi Bouzid, Tunisia, on 17 December 2010, a vegetable seller named Mohamed Bouazizi set fire to himself to protest local authorities' indifference to police misconduct; this action against an unresponsive and corrupt government set off a wave of change in North Africa and the Middle East that has yet to run its course. Governments fell to massive popular protests in Tunisia and Egypt. Similar protests have led to repression in Bahrain, brutal repression in Syria, and civil war and NATO military intervention in Libya. Each country is unique, but increasing our knowledge of common aspects of social identity, organization, and interaction may help us to understand, respond to, and perhaps even forecast such events. New social media help to spread protests and organize resistance to government attempts at repression. Characterizing the roles of these media and extracting information from them are important parts of understanding these events. The DoD has recognized that this overall domain, termed "human dynamics," is important to the complex operations the department is called on to conduct; this issue of the Johns Hopkins APL Technical Digest *highlights a number of research and advanced development projects through which APL is responding to these needs.*

INTRODUCTION

In March 2009, the Defense Science Board Task Force published a report, *Understanding Human Dynamics*, for the Under Secretary of Defense for Acquisition, Technology, and Logistics. It characterized human dynamics as "the actions and interactions of personal, interpersonal, and social/contextual factors and their effects on behavioral outcomes."[1] Its terms of reference began:

> Increasing understanding of adversaries, their operating environment, and the relevant host population is important to conduct complex operations (including stability, security, transition and reconstruction operations), to devise effective terrorist and insurgent countermeasures, to support strategic communications, and to aid intelligence analysis and planning for contingencies.[1]

One Task Force directive was to assess DoD science and technology investment plans and to identify gaps. Among other things, it identified gaps in the analysis of influence, attitudes, and beliefs; in human and cultural studies; and in human dynamics computational modeling

and simulation tools. It also noted that empirical sociocultural data to populate these tools are often lacking.

APL has a long history of work related to understanding our adversaries, especially in the National Security Analysis Department and its predecessors[2] (see Crossett and Buikema, this issue). We have also developed tools for intelligence analysts in this domain and have capabilities in analysis, research, and technology, which can be used to address these and other challenges in human dynamics. In 2009, APL began a substantial independent research and development (IR&D) program in human dynamics. The program applies our research and advanced development experience to the challenge of improving DoD capabilities in collecting and using human dynamics information both tactically and strategically. Several of the articles in this issue report on progress made by projects in this program as well as in other programs at APL. A number of organizations, including the Office of Naval Research, the Air Force Research Laboratory, and other U.S. government agencies, now sponsor work derived from the IR&D program.

THE ARTICLES

Crossett and Buikema begin the issue with a survey of APL studies of insurgency and irregular warfare and provide a framework for describing and analyzing instances of such conflicts, pointing out the value of thinking in terms of "social systems" in several dimensions. They describe challenges in conducting analysis in this domain and review the application of techniques to meet them, including historical research, group gaming in APL's Warfare Analysis Laboratory, and the development of analysis tools and models, some of which are described later in this issue. Looking forward, they mention the need to study self-organized, "leaderless resistance" movements in the Internet age. Written before recent events of the Arab Spring, that comment is particularly prescient and also points to research goals of several of the other projects described in this issue.

Bos et al. follow with a description of sociocultural modeling projects of the kind mentioned by Crossett and Buikema. They start with a general description of such models and discuss the key challenge of validating models in this area. They describe the Social Identity Look-Ahead Simulation (SILAS), an agent-based model of social identity that connects religion and ethnicity to political affiliation in Nigeria (chosen for its combination of strategic importance, availability of relevant survey data, and complex internal identity conflicts). The model was designed to predict how the software agents, connected to groups by affinity, would align in identity conflicts. The expectation is that this will provide useful information about alignment in the real population. (One element of the model is the spread of sentiment through agents' affinity links to the identity groups. The next article, by Fink et al., discusses the discovery of sentiment in a real population.) Bos et al. also describe the incorporation of SILAS into a larger model used in the kind of group game discussed by Crossett and Buikema.

The next two articles, by Fink et al. and McNamee et al., discuss how data can be extracted from specific collections of text to provide information relevant to human dynamics, e.g., for models and analyses like those described in the previous articles. These efforts connect to APL's longtime, significant work in human language technology. That work was also a major factor in the establishment of the Human Language Technology Center of Excellence near the JHU Homewood campus.[3] (In fact, much of the work done in the McNamee et al. article was performed there.) Collaboration between APL and the Center of Excellence will continue to play an important role in our human dynamics research.

Fink et al. describe work on sentiment analysis, the automated extraction of expressions of positive or negative attitudes from text. Understanding people's attitudes toward events, organizations, nations, and other people is crucial to the larger understanding of social movements, political developments, and responses of local populations to counterinsurgency or stability operations. Extracting sentiment from text is very challenging; positive or negative word identification is not enough. The article uses several examples to demonstrate the complex idiom and sentence construction that determines the nature and target of expressed sentiment. It describes the process by which human annotators provided ground truth for evaluation and to provide training data to statistical classifiers, discusses a process for successively applying coarse- and fine-grained sentiment analysis, and reports on the performance of parsers and classifiers in identifying expressions of sentiment.

The approaches described by Bos et al. and Fink et al. have now been combined under the sponsorship of the Office of Naval Research: applying sentiment analysis to Nigerian social media, tracking sentiment over time and examining variation among ethnic groups. This work was recently highlighted by the Human Social Culture Behavior Modeling Program under the Assistant Secretary of Defense for Research and Engineering.[4]

Sentiment analysis requires the identification of the entities in text (in social media and elsewhere) that are the targets of sentiment. Indeed, many kinds of information discovery in text depend critically on the identification of specific, named entities referred to in the text. McNamee et al. describe this process, including named entity recognition and classification, within-document coreference resolution, cross-document resolution, and entity linking. This last task involves linking references in text to a set of known entities (for example, those in a knowledge base) and is becoming increasingly important in many areas. The article discusses APL innovations in each of these areas and their performance in the various competitions and community evaluations that play an important role in human language technology research.

The work described by Montemayor and Diehl extends information discovery in social media to the

identification of social and organizational *relationships* among people rather than simple facts about them or their attitudes. It introduces the concept of a social query, an interaction with an online repository whose information includes explicit or, more interestingly, implicit data about such relationships. The article describes innovative work applied to the discovery of organizational relationships from e-mails in the public Enron e-mail corpus discovered during the investigation of the Enron Corporation. It also describes a new concept for a social search engine, one that might use, for example, social signals embedded in blog postings to help discover groups or people that might meet a searcher's social needs.

The article by Lin et al. adds the temporal domain to discovery and analysis in human dynamics. In many situations, particularly in operational and tactical surveillance, detecting patterns of human behavior is a crucial task. Surveillance and sensor systems like video monitoring can provide vast amounts of data. This volume of data, however, is more than can be monitored in real time by human analysts to detect potentially significant behavior patterns. In addition, suspect patterns can be similar to those of benign activity, complicating automated detection and alerting. The article describes approaches for representing behavior patterns, for user construction of queries and specification of these patterns, and for the efficient discovery of such patterns in large data sets. (Motivating examples in the article come from the notable TV show *The Wire*.)

Our interest in human activities is not limited to those of potential adversaries or large populations. Understanding our own warfighters' capabilities and limitations is crucial to effective human systems integration, ergonomic design, and crew capability management. APL's substantial experience in human systems integration and cognitive engineering[5] is continually applied in these areas, as evidenced in the article by Moundalexis et al. The authors survey the area of crew endurance, discussing factors that determine it, the nature of crew endurance management programs, and existing programs in the DoD, Coast Guard, and Department of Transportation. They also describe several APL crew endurance research efforts in a wide range of applications, including crew modeling, effects on situation awareness, watchstanding scheduling, soldier's load, and ship motion. Endurance concerns (and human factors in general) apply in all areas of military and civil operations; a greater understanding of human endurance will help enhance counterinsurgency operations as well as shipboard activities.

CODA

When I began working at APL more than 30 years ago, our challenges lay in developing technology and engineering systems to deal with threats to our national security. That has not changed, of course, but now we face a radically changed environment. Then threats changed slowly and were clear, localized, and well defined. Now threats change rapidly, are hidden by intent or by nature, and are worldwide and amorphous. In response, APL is applying longstanding capabilities and developing new ones to help our sponsors and the nation deal with this new environment. The modern imperative for U.S. counterinsurgency forces is "learn and adapt."[6] This imperative also applies to the organizations, like APL, that support counterinsurgency forces and their mission.

REFERENCES

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