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# US Army Research Laboratory (ARL) South Partnership Summit 2018

by Heidi Maupin

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# US Army Research Laboratory (ARL) South Partnership Summit 2018

by Heidi Maupin  
*Office of the Director, ARL*

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## Contents

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<b>1. Event Summary</b>	<b>1</b>
1.1 Key Outcomes and Comments	1
1.2 Next Steps	2
<b>2. Perspectives from the University of Texas and Texas A&amp;M Systems</b>	<b>2</b>
<b>3. Summaries of Breakout Sessions</b>	<b>3</b>
3.1 Human Performance/Synthetic Training Environments	3
3.1.1 Top Points	3
3.1.2 Collaboration and Community	3
3.1.3 Participants	4
3.2 Artificial Intelligence/Machine Learning	5
3.2.1 Top Points	5
3.2.2 Collaboration and Community	5
3.2.3 Participants	5
3.3 Cyber and Electromagnetic Technologies for Complex Environments	6
3.3.1 Top Points	6
3.3.2 Collaboration and Community	6
3.3.3 Participants	7
3.4 Synthetic Biology	7
3.4.1 Top Points	7
3.4.2 Collaboration and Community	7
3.4.3 Participants	8
3.5 Tactical Unit Energy Independence	8
3.5.1 Top Points	8
3.5.2 Collaboration and Community	9
3.5.3 Participants	9
3.6 Human–Agent Teaming	10
3.6.1 Top Points	10
3.6.2 Participants	10
<b>4. Other Ideas</b>	<b>10</b>

<b>Appendix. University Summaries/Posters/Agenda</b>	<b>12</b>
<b>List of Symbols, Abbreviations, and Acronyms</b>	<b>13</b>
<b>Distribution List</b>	<b>14</b>

## **1. Event Summary**

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As summarized by Dr Michelle Atchison, University of Texas System, and Dr Dimitris Lagoudas, Texas A&M.

This first-time event was hosted by Rice University to bring together 19 major academic partners in the region with key US Army Research Laboratory (ARL) staff to share updates on research, discuss key development challenges and interests, and network across the attending organizations. On the first day of the ARL South Partnership Summit, Dr Alexander Kott, ARL Chief Scientist, provided overviews of the nine ARL Essential Research Areas (ERAs). In total, 42 ARL staff and 130 participants from 19 universities attended. The second day's agenda concentrated on technical discussions among subject matter experts in a series of breakout sessions. A special session to highlight diversity in Science, Technology, Engineering, and Mathematics (STEM) was led by Dr Patrice Collins, ARL Outreach Special Programs Manager.

### **1.1 Key Outcomes and Comments**

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Key outcomes and comments included the following:

- This was a first-of-its-kind event allowing academic partners to gather and meet with ARL staff for specific review and discussion of priorities for ARL South and the broader ARL Open Campus Initiative.
- Academic attendees praised ARL for providing this convergence forum that is a unique opportunity for academics to gather.
- Follow-on summits may not be needed or perhaps could be considered for a biannual schedule.
- Spin-off forums by technical focus were recommended to support deep-dive reviews on a smaller scale.
- The regional summit enhanced cooperation and awareness among the participants on ongoing research efforts and the possibility for intra-campus collaboration.
- The proposed way ahead is to use summit information to further define ARL South in three ways:
  - 1) Core research activities by university (primary/secondary activities). Incorporating regional ties and organizations to further expand ARL research support.

- 2) Other strengths and possible research topics for future ARL consideration in the region include academic and government organizations with a primary focus in these areas and emerging capabilities. Additional consideration will be given to possible collaboration with industry elements.
  - 3) Support for other Army activities in the region that could leverage ARL South activities and results.
- Information from the meeting will be shared with other ARL staff and regional leads for possible interregional development and overall strategy development options for ARL.

## **1.2 Next Steps**

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The following next steps were identified:

- 1) Work with group leaders identified by ARL for the specific areas described in Section 1.1.
- 2) Work with partners/universities to identify collaborative efforts and common facilities of interest to ARL.
- 3) Technical specific groups formed during the summit will immediately begin meeting regularly to continue building the robust research programs essential to success for ARL.

## **2. Perspectives from the University of Texas and Texas A&M Systems**

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Session led by Dr Michelle Atchison, University of Texas System, and Dr J Martin Scholtz, Texas A&M.

In order to seize upon the opportunities available to us through the US Army's Open Campus research model, the systems make the following observations and recommendations.

The principal investigators are the key focus for successful collaboration supported by system-level advocacy/support. Partnerships are established by mutual research interests among trusted researchers. While reaching agreements on research collaborations, well-defined objectives and goals are crucial. Resources should be scoped and identified to meet research requirements.

What makes this model successful will be our researchers conceptualizing “outside the box” research projects that will be mutually beneficial. Objectives and goals should be well defined since they are crucial to program success. Multiple disciplines that include hard and soft sciences will lead to robust solutions to technical problems. Creative thinking will play a major role as we leverage partnerships and networks. We have to identify and exploit strengths among all institutions to capitalize on complementary capabilities.

Once researchers from multiple institutions have achieved trust and identified beneficial research opportunities, they should inform university/agency administration for extra support in terms of coordination, logistics, and connectivity with ARL administration. Proactive communication and idea generation is essential. University faculty should be in contact with ARL researchers and be encouraged to initiate ideas and discussions.

### **3. Summaries of Breakout Sessions**

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#### **3.1 Human Performance/Synthetic Training Environments**

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Session led by Dr Valerie Rice, ARL.

##### **3.1.1 Top Points**

The session participants identified technologies essential to the success of meeting Army requirements in this area. Physiological sensing and imaging that include thermal sensing, optical wavelengths, and Magnetic Resonance Imaging are important biomarkers. We must advance existing biological (neuro) computational modeling and simulation. We can advance armor development to prevent injuries, and also treat injuries if they do occur using injury mechanisms characterized through both animal and human models.

The group discussed the need to advance simulation and animation for augmented learning, including virtual reality and immersion, keeping feasibility, usability, and maintainability in mind. Other priority areas of research will lead to interventions to improve cognitive and physiological functions (neuromodulation, medical therapeutics, and microbiome). And finally, big data analysis and sharing are essential in rapidly advancing in these areas. While not part of ARL’s purview, the group emphasized the need for further research regarding post-traumatic mental health.

##### **3.1.2 Collaboration and Community**

The following are capabilities/facilities that the group identified:

- Visualization lab at Texas A&M (and others)
- Big 10 academic alliance: Traumatic brain injury collaboration
- NASA food science (Texas A&M) and training center
- Mind Research Network (MRN)
- Food protein center, microbiome (University of Oklahoma, Texas A&M)
- Simulation centers (blast centers/robotic rehab)
- Biological, computational, and deterministic models
- Sensors Center (A&M)

### **3.1.3 Participants**

- Wendy Leonard, ARL
- Morgan Barnes, Rice University
- Bart Sheinberg, Houston Community College
- Antony Passaro, ARL West
- Thaddeus Thomas, ARL
- Sungwon Shin, Texas Technical University
- Marilyn Korhonen, University of Oklahoma
- Melany Dickens-Ray, University of Oklahoma
- Zahed Siddique, University of Oklahoma
- Mary Jo Daniel, University of New Mexico
- Marv Lutnesky, Texas A&M University San Antonio
- Gary Boykin, ARL South
- Heidi Maupin, ARL
- Narisimha Reddy, Texas A&M University
- Dawn Weatherford, Texas A&M University San Antonio
- Mike O'Brien, Texas A&M University San Antonio

## **3.2 Artificial Intelligence/Machine Learning**

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Session led by Dr Tien Pham, ARL.

### **3.2.1 Top Points**

The group emphasized the context of Dirty, Dinky, Dynamic, and Deceptive Data (D5) context. It is essential for the Army to consider mobility in multi-domain battle, including the physical domain as well as the cyber domain. The group discussed big data versus little data, to include volume, variety, velocity, and value. Other technical requirements include adversarial learning and reasoning, as well as interpretability and explain ability. ARL is establishing the Army Artificial Intelligence Institute (A2I2) that will support research and collaboration in artificial intelligence (AI) and machine learning (ML) for autonomy.

### **3.2.2 Collaboration and Community**

The group determined a need for future follow-on meetings and recommended that prior to meetings short-term challenges should be distributed for hackathons. Concrete and measurable stretch demonstration and challenge problems should be developed. Capstone projects should be undertaken by universities that incorporate or are derived from these challenge problems. To encourage networking and optimize individual expertise, cohorts of students from different universities should be established and placed for a period of time at ARL alongside Army researchers. Finally, access and sharing of data and models will rapidly advance autonomy technology.

### **3.2.3 Participants**

- S F Cruz, NASA Johnson Space Center
- Patrick Bridges, University of New Mexico
- Abdul Serwadda Texas Technical University
- Andres L'Afflitto, University of Oklahoma
- Joe Heppert, Texas Technical University
- Dy Le, Texas Technical University
- Harris Edge, ARL
- Emmett Tomai, UT Rio Grande Valley
- Michelle Atchison, UT System

- Floyd Wormley, University of Texas at San Antonio
- John Fossaceca, ARL
- Simon Sheather, Texas A&M University
- Enrico Pontelli, New Mexico State University
- Yan Huang, University of North Texas
- Ahmed Tewfik, University of Texas at Austin
- Shouhuai Xu, University of Texas at San Antonio
- Jennifer Holmes, University of Texas at Dallas
- Garrett Warnell, ARL

### **3.3 Cyber and Electromagnetic Technologies for Complex Environments**

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Session led by Mr Jerry Clarke, ARL.

#### **3.3.1 Top Points**

While the group quickly ascertained that the topic was broad, critical points were highlighted:

- Cyber and network security: “connect ‘em and protect ‘em”
- Deception and camouflage: human behavior versus technology
- Alternatives to radio wave communication: visible or ultraviolet scattering
- Human dynamics of cyber security

#### **3.3.2 Collaboration and Community**

The group concurred that the community of partners must place more focus on the ARL ERA lines of effort. The group will elicit talent, creativity, and expertise that were very evident among all the participants. Each carries a forte that can complement and/or augment those of the group. The group expressed a desire to design and carry out a cyber-related “Mad Scientist” competition. The group discussed the cultural differences between academia and the Army, and how these must be considered to ensure a meaningful partnership.



### **3.3.3 Participants**

- Shuman Alam, Prairie View A&M University
- Kam Lulla, NASA/J
- Nick Large, University of Texas at San Antonio
- Jim Wall, Texas A&M University
- Jaime Acosta, ARL
- Salamah Salamah, University of Texas at El Paso
- Don Headley, ARL
- David Aleomon, University of Texas at San Antonio
- Changzhi Li, Texas Technical University
- Daniel Krawczyk, University of Texas at Dallas
- Murat Kantarcioglu, University of Texas at Dallas
- Jonathan Bakdash, ARL
- Tahsin Khajah, University of Texas at Tyler
- Izzat Alsmadi, Texas A&M University San Antonio
- Norwood, ARL South

## **3.4 Synthetic Biology**

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Session led by Dr Dimitra Stratis-Cullum, ARL.

### **3.4.1 Top Points**

Ideally, the collaboration will produce near-term proof-of-concepts that will lead to achieving long-term goals. Biosensors (e.g., sprinkle biomaterials) should be developed for assessment. Ideas for long-term projects include fast generic/modular/reprogrammable tools (e.g., adaptable for the Soldiers' needs), sensing for specific light (e.g., directed energy sensing), and detection patches (e.g., wearable biosensing). Other applications include biology for corrosion (i.e., purposeful induction or prevention, or nonproliferation materials).

### **3.4.2 Collaboration and Community**

Consensus among the group was that there is a need to make ARL's challenges well known. There is a need for improved communication. This could be

accomplished by having ARL scientists on university committees. The group suggested creating virtual centers to engage essential contributors. Also, ARL-sponsored projects within the universities would advance technology while increasing awareness of Army problems and requirements. Recruiting veterans in this specialized field would facilitate connection of new technologies with Army problems and solutions.

Other biotechnology ideas were discussed but are not specific to synthetic biology. These include the following:

- 1) Bio-inspired/biomimicry: Making and breaking materials through synthetic biology to alter its function (triggering degradation or controlling self-healing).
- 2) Human performance: Probiotics that lead to enhanced productivity and resiliency (e.g., minimizing stress, strain, or local health issues).

### **3.4.3 Participants**

- Jianzhi Li, University of Texas Rio Grande Valley
- Steven Graves, University of New Mexico
- Alexander Kott, ARL
- Randall Hughes, University of Texas at Austin
- Jonathan Silberg, Rice University
- Josh Banta, University of Texas at Tyler
- Hanadi Rifai, University of Houston
- Arum Han, Texas A&M University

## **3.5 Tactical Unit Energy Independence**

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Session led by Dr Brett Piekarski, ARL.

### **3.5.1 Top Points**

The group realized quickly that they needed to think bigger than individual efforts in order to achieve world-class leadership in this field. Specific technical areas highlighted included hybrid approach, using intelligent systems (i.e., AI/ML for energy usage and planning), energy use cognitive load, and human sources of energy. Finally, the group recognized that there is an established need to understand energy balance and Army needs.

### **3.5.2 Collaboration and Community**

The group recognized the need to meet quickly and more often. They will plan a workshop to explore a consortium on unmanned aerial vehicle power. They want to clearly identify facility capabilities of all the partners.

### **3.5.3 Participants**

- Brett Piekarski, ARL
- Kim Mai Tran, Rice University
- Bruce Geil, ARL
- Ed Shaffer, ARL
- Mike Giesselmann, Texas Technical University
- Jaret Riddick, ARL
- Bob Hebner, University of Texas at Austin
- Mark Tschopp, ARL Central
- Dimitris Lagoudas, Texas A&M University
- George Zouridakis, University of Houston
- Stephen Berkebile, ARL
- T Randall “Randy” Lee, University of Houston
- Yirong Lin, University of Texas at El Paso
- Arash Mafi, University of New Mexico
- Mike McGinnis, University of Texas at Tyler
- Erick Jones, University of Texas at Arlington
- Elias Rigas, ARL
- Miki Balasubramanya, Texas A&M University
- Gary Wood, ARL
- Tanya Chantawansri, ARL
- Venkat Selvamanickam, University of Houston
- Baburaj Eranezhuth, Rice University/Clarkson Aero
- Robert Huck, University of Oklahoma

## **3.6 Human-Agent Teaming**

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Session led by Dr Kaleb McDowell, ARL.

### **3.6.1 Top Points**

The group discussed the best ways to connect to better communicate goals and determine a best operational method. They decided that an electronic forum would be the ideal way to brainstorm, solving problems with the brightest minds engaged. There was a concern about how to get and keep funding, and again, the group realized that through regular engagements, opportunities for funding could be communicated and embraced jointly.

### **3.6.2 Participants**

- Sandy Howard, ARL
- George Zouridakis, University of Houston
- Mike O'Brien, Texas A&M University San Antonio
- Jim Murphy, New Mexico State University
- Matthew Jensen, University of Oklahoma
- Enrique Barrera, Rice University

## **4. Other Ideas**

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Session led by Dr Scott Schoenfeld, ARL, and Dr Peter Reynolds, Army Research Office.

Each breakout session reported other ideas that, while not directly related to their session, were worthy of mentioning to the summit participants. Many of these other ideas were brought up by multiple groups. They are as follows:

- Now that contacts have been made among the technical disciplines, technical-specific meetings should occur to focus on ARL ERA lines of effort that will lead to creating solutions for Army-specific problems that will satisfy Army requirements.
- This networking meeting is the start of what will be meaningful, trusting, long-term relationships. It is important to cultivate an environment that allows creativity and productivity.
- Ways to elicit talent, creativity, and expertise are through synergistic events such as hackathons and technical-specific "Mad Scientist" competitions.

- Army and academia partners have to realize and be sensitive to cultural differences.
- Research efforts must have concrete and measurable evaluation criteria.
- Access to partner facilities will lead to quicker technology advancement. This includes computational resources, data, and simulators/simulation environments, testing facilities, and so on.
- Army should provide input to universities during faculty hires so universities can recruit faculty who can support research relative to Army requirements.
- The ARL South community will benefit through outreach to underserved student populations by building expertise in the STEM fields. ARL South will benefit by including small and growing institutions with fewer resources in their partnerships.

## **Appendix. University Summaries, Posters, and Agenda**

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This appendix appears as a PDF attachment to this report.

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## List of Symbols, Abbreviations, and Acronyms

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A2I2	Army Artificial Intelligence Institute
AI	artificial intelligence
ARL	US Army Research Laboratory
D5	Dirty, Dinky, Dynamic, and Deceptive Data
ERA	Essential Research Area
ML	machine learning
MRN	Mind Research Network
NASA	National Aeronautics and Space Administration
STEM	Science, Technology, Engineering, and Mathematics

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