

23<sup>rd</sup> International  
Command and Control  
Research & Technology Symposium  
6-9 November, Pensacola, Florida, USA

2018

# *Symposium Program*

***Theme: Multi-Domain C2***

Hosted by  
Florida Institute for Human Machine Cognition



**Symposium Chair**  
David Alberts

**Program Chair**  
Ken Teske

**Arrangements Chairs**  
Niranjan Suri  
Mark Miller

**Host Arrangements**  
Michelle Bowers



## Tuesday, November 6th

1A

08:00-09:00 Breakfast, Check-in and On-site Registration  
09:00-09:30 Symposium Welcome and Administrative Remarks

2A

09:30-10:30 Multi-Domain C2 Challenges and  
Preview of Symposium Sessions  
10:30-11:00 Coffee Break

3A

11:00-12:00 Cyber Risk to Mission  
John J. Garstka  
Director, Cyber, OUSD(A&S) I&IPM)

12:00-13:00 Lunch

13:00-15:00 Track Sessions 4A, 4B, 4C

15:00-15:30 Coffee Break

15:30-17:30 Track Sessions 5A, 5B, 5C

17:30-19:00 Reception and Tour of IHMC Facility

## Wednesday, November 7th

6A

08:00-08:30 Breakfast, Check-in and On-site Registration  
08:30-09:00 Reflections  
09:00-10:00 Cost of C2 in Multi-Domain Operations:  
NATO Perspective  
Leah Treppel, Comptroller  
NATO Special Operations Headquarters

7A

10:00-10:30 Coffee Break  
10:30-12:00 Multi-Domain C2 International Perspectives  
Chair: William C. Fleser, USSOCOM  
Magdalena Granasen (SWE), Alex Kalloniatis (AUS),  
Jessaji Odedra (GBR), COL Floricica (ROU)  
COL Jablonski (POL)

12:00-13:00 Lunch

13:00-15:00 Track Sessions 8A, 8B, 8C

15:00-15:30 Coffee Break

15:30-17:30 Track Sessions 9A, 9B, 9C

18:30-21:00 IHMC Hosted Dinner

## Thursday, November 8th

10A

08:00-08:30 Breakfast, Check-in and On-site Registration  
08:30-09:00 Reflections  
09:00-10:00 The Children of Colossus: The Lost History of Cybernetics...and Why it Matters in C2 Today -- Colin Williams, Software Box Ltd, University of Warwick, and De Montfort University

11A

10:00-10:30 Coffee Break  
10:30-12:00 Explainable Artificial Intelligence Panel  
Panel Chair: Robert R. Hoffman Panelists: Gary Klein, Tim Miller, Shane T. Mueller, David Aha

12:00-13:00 Lunch  
13:00-15:00 Track Sessions 12A, 12B, 12C  
15:00-15:30 Coffee Break  
15:30-17:30 Track Sessions 13A, 13B, 13C

## Friday, November 9th

14A

08:00-08:30 Breakfast  
08:30-09:00 Reflections  
09:00-10:00 NATO Research Group SAS-143  
Multi-Domain C2: A Progress Report and Call for Participation

15A

10:00-10:30 Coffee Break  
10:30-12:00 Best Paper Award  
Symposium Highlights: Track Chair Perspectives  
12:00-13:00 Lunch

**END OF SYMPOSIUM**

## Tracks and Track Chairs

- Track 1 Operational Issues: Coalition C2 (Mark Miller)
- Track 3 Battlefields of the Future and Internet of Intelligent Things (Russell Bryant)
- Track 4 Cognitive and Social-Technical Challenges (Elizabeth Bowman and Sue Case)
- Track 5 Highly Connected, Automated, and Autonomous Forces  
(Marco Manso and Frank-Trethan Johnsen )
- Track 6 Interoperability, Integration, and Security (Mark Pullen)
- Track 7 Human Information Interaction (Adrienne Raglin)
- Track 8 Methodology, Experimentation, Analysis, Assessment, and Metrics (Patrick Guerin)
- Track 9 Knowledge Systems (Ken Teske and Jeffrey Lauver)
- Track 10 Cyberspace Challenges (Richard Metzger)

**Tuesday, November 6<sup>th</sup>**

**Track Sessions 13:00 – 15:00**

### **Track 7 - Human Information Interaction**

13:00 Mark Mittrick, John Richardson, Timothy-Hanratty,  
Michael McGuire and Joyram Chakraborty

**Measuring the Effects of Augmented  
Visualizations Through Eye Gaze Tracking**

13:30 Nico Bau, Michael Gerz, Fahrettin Gökgöz, Hans-  
Christian Schmitz, Daniel Mück, Sven Endres  
and Sylvia Käthner

**A Newsfeed for C2 Situational Awareness**

14:00 Derrik Asher, Sean Barton and Erin Zaroukian  
**Adapting the Predator-Prey Game Theoretic  
Environment to Army Tactical Edge Scenarios  
with Computational Multiagent Systems**

14:30 Andre Harrison, Darius Jefferson, Adrienne Raglin,  
Brian Jalaian and Michael Lee

**A survey of feature space reduction methods  
for context aware processing in IoT networks**



**4A**

**Tuesday, November 6<sup>th</sup>**  
**Track Sessions 13:00 – 15:00**

**Track 1- Operational Issues**

13:00 Ken Teske, Patrick Guerin and Mark Miller  
**Decoupling Command from Control**

13:30 Russell Bryant  
**Connecting Command and Control with Clashing Tribal and Civilizational Characteristics – Opportunities and Limitations**

14:00 Ken Teske, Mark Miller, Patrick Guerin, Jeffrey Lauver  
**Building a Coalition Multi-Domain Learning Environment**

14:30 Ken Teske, Patrick Guerin and Mark Miller  
**C2 Agility & Approaches Enabling Dynamic Security Control Sets and Overlays**

**Track 5 - Highly connected, Automated, and Autonomous Forces**

13:00 Neil Rowe, James Zhou and Arijit Das  
**Distributed combat identification of aircraft**

13:30 Marco Manso, Frank Johnsen, Kevin Chan, Norman Jansen, Andrew Toth and Trude Bloebaum  
**Mobile Tactical Force Situational Awareness: Evaluation of Message Broker Middleware for Information Exchange**

14:00 Jeff Vu, Samia Ali, Viral Bhalodia, Johanna Flores Haiqiao Lin, Daniel Silva, Allen Qiu, Luis Martinez, Stephanie Hsieh, Steve Fogg, Jose Carreno and James Jen  
**Using automation to speed up software delivery to the fleet**

14:30 George Galdorisi  
**Producing Military Unmanned Systems Even Lawyers Can Love**

**15:00-15:30 Coffee Break**

4B

4C

**Tuesday, November 6<sup>th</sup>**  
**Track Sessions 15:30 – 17:30**

**Concept Papers**

**5A**

15:30 Peter Houghton and Donna Amey  
**Alternative Thinking Team**

16:00 Niklas Hallberg, Magdalena Granåsen, Anders Josefsson,  
and Christina Ekenstierna **Framework for  
C2 Concept Development: Exploring  
Design Logic and Systems Engineering**

16:30 Ulrik Spak and Mats Carlerby  
**Modelling command and control: The challenge of  
integrating structure and behaviour**

17:00 James Michaelis  
**Towards human-in-the-loop extensions  
for IoBT service management**

**Concept Papers**

**5B**

15:30 David Alberts  
**Multi Domain Operations: What's New?  
What's Not: Implications for C2**

16:00 David Alberts  
**Agile, Multi-domain C2 with Imperfect Partners**

**Tuesday, November 6<sup>th</sup>**  
**Track Sessions 15:30 – 17:30**

**Concept Papers**



**5C**

15:30 Kevin Chan, Kelvin Marcus, Gregory Judd and Peter Boyd

**Semantically Managed Autonomous and Resilient Tactical Networking (SMARTNET) and Hybrid C2 operations**

16:00 Björn J E Johansson, Kristofer Bengtsson, Per-Anders Oskarsson, Peter Svenmarck and Rogier Woltjer

**C2 of joint autonomous intelligent units – a research project**

16:30 Gilles Desclaux and Prebot Baptiste

**Command and Control at the Autonomy and Cognitive Era: For a decision cycle augmented by the symbiosis between human and systems**

**17:30-19:00 ICCRTS Reception  
Tours of IHMC Facility  
(18:00 and 18:30)**

**Wednesday, November 7<sup>th</sup>**

**Track Sessions 13:00 – 15:00**

**Track 8 - Methodology, Experimentation, Analysis,  
Assessment, and Metrics**

13:00 Andrew Sollish, Neil Rowe, Sean Everton and  
N. Wayne Porter

**Finding correlations between ship positions**

13:30 Rudolph Oosthuizen, Cobus Venter and  
Chris Serfontein

**Model Bases Systems Engineering Process  
for Complex Command and Control Systems**

14:00 Rachna Lorke, Greg Judd, Vanja Radenovic and  
Peter Boyd

**Investigating the C2 benefits of dynamic and  
autonomous information prioritization and  
control over disrupted, intermittent and  
limited tactical edge networks**

14:30 Richard McCourt and Ahmed Ghanmi

**On the Use of Topic Modeling for Lessons  
Learned Analysis**

**8A**

**Track 4 - Cognitive and Socio-technical Challenges**

13:00 Mark Nissen

**Dynamic C2 Design for Teams of Autonomous  
Systems and People**

13:30 Judith van de Kuijt and Aletta Eikelboom

**Self-synchronization as additional approach  
to traditional C2**

14:00 Reinout Pieneman, Casper Van den Broek,  
Bas Gerrits, Jacomien De Jong and Marcel Van Hekken

**The networked command environment: architecture  
and functional design**

14:30 Sue Kase, Simon Su, Vincent Perry and Andrew Durkee

**Observations of individual and team understanding in  
augmented reality mission planning**

**8B**



**Wednesday, November 7<sup>th</sup>**

**Track Sessions 13:00 – 15:00**

**Track 3 - Battlefields of the Future and the  
Internet of Intelligent Things**

13:00 Tim Lamballais Tessensohn, Bob van der Vecht  
and Aletta Eikelboom

**How to cooperate with intelligent machines:  
Lessons for defense operations from  
the integration of AI and robotics across  
multiple domains**

13:30 Filippo Poltronieri, Cesare Stefanelli, Niranjan Suri  
and Mauro Tortonesi

**Analyzing and Evaluating Information-Centric  
and Value-based Fog Service Architectures in  
Military Environments: The Phileas Simulator**

14:00 Frank Johnsen, Trude Bloebaum, Marianne Brannsten  
and Ketil Lund

**Using Open Standards for Utilizing IoT  
Sensors in a Smart City Scenario**

14:30 Magdalena Granåsen, Per Barius, Niklas Hallberg  
and Anders Josefsson

**Exploring Mission Command in a Concept for Future  
Command and Control - A Small State Perspective**



**8C**

**15:00-15:30 Coffee Break**

**Wednesday, November 7<sup>th</sup>**  
**Track Sessions 15:30 – 17:30**

**Concept Papers**

**9A**

15:30 Reinout Pieneman, Marcel van Hekken, Roy Benda,  
Kees van Dongen, Willem van den Bosch and Marco  
Brattinga  
**Federated Information Release Module: an outline**

16:00 Ulrik Spak and Isabell Andersson  
**Design logic in practice: A method to extract  
design criteria for future C2 systems**

16:30 James Schaffer  
**Transparent Approaches to Recommender  
Systems for C3I**

17:00 Nandi Leslie  
**Using Semi-Supervised Learning for Flow-  
Based Network Intrusion Detection**

**Concept Papers**

**9B**

15:30 Jordan Miller, Yazan Qasrawi and Abdeslem Boukhtouta  
**Emerging technologies for sustainment for  
Command and Control of fututre operations**

16:00 Sean Barton and Sue Kase  
**Social Terrain Modeling: A four-stage  
framework for Army research**

16:30 Paul Labbé  
**Potential advantages of cognitive sensor-to-  
effector loops (CStELs)**

17:00 Drew Kogon, Timothy Hanratty and Eric Heilman  
**Towards a Social-Sense Enabled Military  
Decision Making Process**

**Wednesday, November 7<sup>th</sup>**

**Track Sessions 15:30 – 17:30**

**Track 3 - Battlefields of the Future and the  
Internet of Intelligent Things**

15:30 Zhuyun Duanmu, Xiaobin Mao and Heng Wang  
**The conceptual model of agile command and  
control system**

**Concept Papers**

16:00 Eldad M. Shamash  
**Cellular approach to Multi-Domain Battle-  
space management - The role of cognitive  
models in joint and coalition forces' success**

16:30 Erin Zaroukian  
**Information extraction for optimized human  
understanding and decision making**

17:00 Alexander Kalloniatis  
**Next Steps in the Fifth Generation  
Headquarters Concept**

**18:00-21:00 IHMC Hosted Dinner  
5Eleven - 511 S Palafox Street**



**9C**

Thursday, November 8<sup>th</sup>

Track Sessions 13:00 – 15:00

**Track 7 - Human Information Interaction**

- 13:00 Douglas Summers-Stay, Adrienne Raglin and Dandan Li  
**Reasoning with Vector-Based Knowledge Representations**
- 13:30 Allison Newcomb, Jason Ellis and Travis Parker  
**Blending Software Agents with Human Network Defense Teams**
- 14:00 Gregory Shearer  
**Integrating Human Knowledge in a Semi-Autonomous Prioritization System: An Approach for Improving Network Intrusion Detection Efficiency**
- 14:30 Aleandre Bergeron Guyard  
**A Contextual Query and Analysis Framework for Heterogeneous Unstructured Text**

12A

**Track 10 - Cyberspace Challenges**

- 13:00 Patrick Guerin, Ken Teske and Mark Miller  
**A Methodology for Managing Multiple, Complex, C2-Enabling, Cybersecurity Research and Development Efforts**
- 13:30 Carissa Hall and Neil Rowe  
**Options for persistence of cyberweapons**
- 14:00 Jonathan Agre, Ronald Bechtold, Karen Gordon and Marius Vassiliou  
**IT Asset Management for Cyber Defense**
- 14:30 David Alberts  
**C2 of Cyberspace Operations: Is a New C2 Approach Required?**

12B

**Thursday, November 8<sup>th</sup>**  
**Track Sessions 13:00 – 15:00**

**Track 6 - Interoperability, Integration, and Security**

- 13:00 George Galdorisi and Stephanie Hszieh  
**Command and Control for the Global Network of Navies**
- 13:30 Lorenzo Campioni, Roberto Fronteddu, Rita Lenzi,  
Mattia Mantovani, Alessandro Morelli, Filippo Poltronieri,  
Cesare Stefanelli, Niranjani Suri and Mauro Tortonesi  
**Efficient and Secure Multi-domain Information Sharing in  
Tactical Networks**
- 14:00 Simo Huopio  
**Thou shalt not fail - Targeting Lifecycle-Long  
Robustness while being vigilant for the Black  
Swans**
- 14:30 Adam Brook and Kevin Galvin  
**A Framework for Advanced Decision Support  
in Multi-domain and Coalition Operations**



**12C**

**15:00-15:30 Coffee Break**

**Thursday, November 8<sup>th</sup>**  
**Track Sessions 15:30 – 17:30**

**Track 9 - Knowledge Systems**

15:30 Johan Schubert, Joel Brynielsson, Mattias Nilsson,  
and Peter Svenmarck

**Artificial Intelligence for Decision Support in  
Command and Control Systems**

16:00 Björn J E Johansson, Mats Carlerby and  
David S Alberts

**A Suggestion for Endeavour Space Dimensions**

**13A**

**Concept Papers**

16:30 Hengameh Irandoust

**C2 and the Primacy of Information**

17:00 Reinout Pieneman, Mike Schenk, Bas Gerrits  
and Casper Van den Broek

**Data centric information provision: an outline**

**Concept Papers**

15:30 Marius Vassiliou and David Alberts

**The Mission Value Pyramid: A Framework for  
Basic Research Supporting C2, with  
Examples**

16:00 Mark Dennison, Jerald Thomas, Theron Trout  
and Evan Suma Rosenberg

**Assessing the quantitative and qualitative  
effects of using mixed reality for operational  
decision making**

16:30 Kyriaki Zafeiroudi and Rebecca Passonneau  
**Knowledge Inquiry for Information Foraging**

17:00 Dandan Li and Douglas Summers-Stay  
**Mapping Distributional Semantics to Formal  
Concept Lattice-based Property Norms**

**13B**

**Thursday, November 8<sup>th</sup>**  
**Track Sessions 15:30 – 17:30**

**Track 8 - Methodology, Experimentation, Analysis,  
Assessment, and Metrics**

15:30 Blake Martin, Kristy Kay, Lisa Tripp, Kent Halverson,  
Lisa Lucia and David Bryant **Multi-  
Modal Measurement for Intelligence  
Analyst Cell Size Optimization**

**Track 6 - Interoperability, Integration, and Security**

16:00 J. Mark Pullen and James Ruth  
**Training Operational Military Organizations in  
a Cyber-active Environment Using C2-  
Simulation Interoperation**



**13C**

**Concept Papers**

16:30 Trude Bloebaum and Frank Johnsen  
**A Hybrid Push/pull C4IS Information  
Exchange Architecture Concept**

17:00 Kevin Diaz  
**Autonomous Hybrid Chassis Breaching  
Systems**



**International C2 Institute**

[www.internationalc2institute.org](http://www.internationalc2institute.org)

## **What is IC2I?**

The International Command and Control Institute (IC2I) is a nonprofit corporation under the US Internal Revenue Code Section 501 (c) (3) created exclusively for scientific and educational purposes. The focus of the Institute is on enhancing our understanding of emerging technologies, and their implications for command and control of complex enterprises and endeavors operating in highly dynamic and contested environments. These technologies are enabling the creation of socio-technical organizations that are learning to leverage networked human-machine collaborations that employ autonomous systems, real and virtual.

## **Why was IC2I created?**

The Command and Control Research Community, composed of an international community of researchers (from industry, academia and government) and practitioners (e.g., military, emergency services), has, over the past 20 years, created an invaluable body of literature that was about to become inaccessible to researchers and practitioners due to uncertain Government funding. The annual gathering of this community, the International C2 Research and Technology Symposium (ICCRTS), was also in danger of being disrupted or discontinued. IC2I was created, in part, to ensure both the continued access to this important body of literature and the continuation of ICCRTS meetings so that researchers could continue to build upon previous work by interacting and collaborating with one another.

## **How is IC2I funded?**

The Institute currently receives no direct Government support. Its creation was funded by private donations. The initial donors established a goal for IC2I to become funded by memberships and proceeds from events and publications. A portion of this year's ICCRTS registration fee will be used to cover the costs of maintaining on-line access to the body of literature and planning for future events. Participants in ICCRTS will receive a one-year membership in the Institute that will enable them to access the symposium proceedings and archives. They will also receive a membership discount to future events.