A Joint Meeting of:

The 4th "Multifunctional Materials for Defense" Workshop

Theme:

Design and Performance of Autonomic, Adaptive and Self-sustaining Systems

The 2017 Annual Review for ONR Program on "Structural Composites & Non-Destructive Evaluation"

The 2017 Annual Grantees'/Contractors' Meeting for AFOSR Program on "Mechanics of Multifunctional Materials & Microsystems"

28 August – 1 September 2017
4075 Wilson Boulevard, Suite 350
Basic Research Innovation & Collaboration Center
Arlington, VA 22203

SPONSORED BY:

Workshop Co-Chairs:

Michael Durstock (Air Force Research Lab)
Shawn Walsh (Army Research Lab)
Geoffrey Cranch (Naval Research Lab)

Joint Organizing Committee:

B.-L. ("Les") Lee (Air Force Office of Scientific Research), ***Co-Chair***
Ignacio Perez de Leon (Office of Naval Research), ***Co-Chair***
David Stepp (Army Research Office), ***Co-Chair***

William Baron (Air Force Research Lab), ***ex officio***
Jeffery Baur (Air Force Research Lab), ***ex officio***
Michael Durstock (Air Force Research Lab)
Gregory Reich (Air Force Research Lab), ***ex officio***
Ajit Roy (Air Force Research Lab)
Richard Vaia (Air Force Research Lab)

Larry Holmes (Army Research Lab)
Christopher Kroninger (Army Research Lab)
William Nothwang (Army Research Lab), ***ex officio***
Daniel O'Brien (Army Research Lab), ***ex officio***
Shawn Walsh (Army Research Lab)
Eric Wetzel (Army Research Lab), ***ex officio***

Geoffrey Cranch (Naval Research Lab)
Peter Finkel (Naval Research Lab)
Keith Perkins (Naval Research Lab)
James Thomas (Naval Research Lab), ***ex officio***

Speakers, PI's & Co-PI's (Non-Gov't):

Narayan Aluru (Univ. of Illinois)
Andres Arrieta Diaz (Purdue Univ.)
Anna Balazs (Univ. of Pittsburgh)
Ray Baughman (Univ. of Texas at Dallas)
Yakup Bayram (PaneraTech, Inc.)
Alexander Bogdanovich (North Carolina State Univ.)
Jonathan Boreyko (Virginia Polytechnic Inst.)
Hugh Bruck (Univ. of Maryland)
Gregory Carman (Univ. of California, Los Angeles)
Fu-Kuo Chang (Stanford Univ.)
Ioannis Chasiotis (Univ. of Illinois)
Yong Chen (Univ. of California, Los Angeles)
Kenneth Church (nScrypt, Inc. / Sciperio, Inc.), ***Keynote***
Nikolaus Correll (Univ. of Colorado)
Alper Erturk (Georgia Inst. of Technology)
Aaron Esser-Kahn (Univ. of California, Irvine)
Philippe Geubelle (Univ. of Illinois)
Somnath Ghosh (Johns Hopkins Univ.)
Victor Giurgiutiu (Univ. of South Carolina)
Satyandra Gupta (Univ. of Southern California)
Ming Han (Univ. of Nebraska)
A. John Hart (Massachusetts Inst. of Technology)
Darren Hartl (Texas A&M Univ.)
Ximin He (Univ. of California, Los Angeles)
Noel Holbrook (Harvard Univ.)
Jonathan Hopkins (Univ. of California, Los Angeles)
Yuhang Hu (Univ. of Illinois)
Guoliang Huang (Univ. of Missouri)
Haiying Huang (Univ. of Texas at Arlington)
Peter Ifju (Univ. of Florida)
Daniel Inman (Univ. of Michigan), ***Invited Review***

David Kisailus (Univ. of California, Riverside)
Antonios Kontsos (Drexel Univ.)
Roy Kornbluh (SRI International)
Nicholas Kotov (Univ. of Michigan)
David Kovar (Univ. of Chicago), ***Invited Review***
Rebecca Kramer (Purdue Univ.)
Sridhar Krishnaswamy (Northwestern Univ.)
Jay Kudva (NextGen Aeronautics, Inc.)
David Lentink (Stanford Univ.)
Donald Leo (Univ. of Georgia)
Jennifer Lewis (Harvard Univ.)
Liping Liu (Rutgers Univ.)
Nanshu Lu (Univ. of Texas at Austin)
Chris Mangun (CU Aerospace, Inc.)
Kurt Maute (Univ. of Colorado)
Majid Minary-Jolandan (Univ. of Texas at Dallas)
Austin Minnich (California Inst. of Technology)
Mohammad Modarres (Univ. of Maryland)
Jeffery Moore (Univ. of Illinois)
SungWoo Nam (Univ. of Illinois)
Ralph Nuzzo (Univ. of Illinois)
Jeffrey Olson (Lockheed Martin Space Systems Co.)
Harry Perkinson (TRI Austin, Inc.)
Kara Peters (North Carolina State Univ.)
Shashank Priya (Virginia Polytechnic Inst.)
Jerry Qi (Georgia Inst. of Technology)
Massimo Ruzzene (Georgia Inst. of Technology)
S. Andrew Sarles (Univ. of Tennessee)
Mark Schulz (Univ. of Cincinnati)
Vesselin Shanov (Univ. of Cincinnati)
Robert Shepherd (Cornell Univ.)
Henry Sodano (Univ. of Michigan)
Nancy Sottos (Univ. of Illinois)
Geoffrey Spedding (Univ. of Southern California)
Abraham Stroock (Cornell Univ.)
Sergei Sukharev (Univ. of Maryland)
C. T. Sun (Purdue Univ.)
Sameh Tawfick (Univ. of Illinois)
Scott White (Univ. of Illinois)
Boris Yakobson (Rice Univ.), ***Invited Review***
Gleb Yushin (Georgia Inst. of Technology)
Pablo Zavattieri (Purdue Univ.)

Speakers, PI's & Co-PI's (Gov't):

Jeffery Baur (Air Force Research Lab - AFRL/RXCCM), ***Invited Review***
Philip Beran (Air Force Research Lab - AFRL/RQVC)
J. Daniel Berrigan (Air Force Research Lab - AFRL/RXAS)
Philip Buskohl (Air Force Research Lab - AFRL/RXAS)
Geoffrey Cranch (Naval Research Lab)
Benjamin Dickinson (Air Force Research Lab - AFRL/RWWN)
Larry Drummy (Air Force Research Lab - AFRL/RXAS)
Michael Durstock (Air Force Research Lab - AFRL/RXAS)
Gregory Ehlert (Air Force Research Lab - AFRL/RXCCM)
Peter Finkel (Naval Research Lab)
Aaron Harrington (Army Research Lab - ARL/VTD)
Kevin Hart (Army Research Lab - ARL/WMRD)
Joseph Hays (Naval Research Lab), ***Invited Review***
Larry Holmes (Army Research Lab - ARL/WMRD)
James Joo (Air Force Research Lab - AFRL/RQVC)
W. Joshua Kennedy (Air Force Research Lab - AFRL/RXCCM)
Christopher Kroninger (Army Research Lab - ARL/VTD)

Benji Maruyama (Air Force Research Lab - AFRL/RXAS)
Keith Perkins (Naval Research Lab)
Gregory Reich (Air Force Research Lab - AFRL/RQVC)
Geoffrey Slipher (Army Research Lab - ARL/VTD)
Christopher Tabor (Air Force Research Lab - AFRL/RXAN)
James Thomas (Naval Research Lab)
Richard Vaia (Air Force Research Lab - AFRL/RXA)
Jan Vandenbrande (Defense Advanced Research Projects Agency), ***Keynote***
Shawn Walsh (Army Research Lab - ARL/VTD)
Eric Wetzel (Army Research Lab - ARL/WMRD)

PI's & Co-PI's (Int'l) *(Not attending)***:**

Douglas Altshuler (Univ. of British Columbia)
Leif Asp (Chalmers Univ. of Technology)
Richard Bomphrey (Royal Veterinary College)
Martin Dunn (Singapore Univ. of Technology and Design)
Paolo Ermanni (ETH Zürich)
Emile Greenhalgh (Imperial College London)
Walter Lacarbonara (Univ. of Rome)
Giulia Lanzara (Univ. of Rome)
Haiwon Lee (Hanyang Univ.)
Andre Studart (ETH Zürich)
Akira Todoroki (Tokyo Inst. of Technology)
Richard Trask (Univ. of Bath)
Jim Usherwood (Royal Veterinary College)
Dan Zenkert (KTH Royal Institute of Technology)

Invitees:

David Carroll (CU Aerospace, Inc.)
Bruce LaMattina (Univ. of North Carolina at Charlotte)
Adam Wickenheiser (George Washington Univ.)

Gregg Abate (Air Force Academy)
Erin Cleveland (Naval Research Lab)
Stephanie McElhinny (Army Research Office)
John Prater (Army Research Office)
Siddiq Qidwai (National Science Foundation)
Ajit Roy (Air Force Research Lab - AFRL/RXAN)
Jim Snyder (Army Research Lab - ARL/WMRD)
Samuel Stanton (Army Research Office)
Katie Thorp (Air Force Research Lab - AFRL/RXCCM)
David Zeppettella (Air Force Research Lab - AFRL/RQVS)

AGENDA

Monday, August 28

Time	Speaker	Title of Presentation
07:30		***Registration***
08:00	**Michael Durstock** AFRL/RX **Shawn Walsh** ARL/VTD **Geoffrey Cranch** NRL	***Opening Remarks***
	Session Chair: ***Dave Stepp (ARO)***	
08:15	**Jan Vadenbrande** DARPA	***Keynote #1 –*** Transformative Design
08:55	**Shawn Walsh** ARL/VTD	Exercising New Tools and Concepts to Expand the Promise of Material Multifunctionality
09:20	**Liping Liu** Rutgers U	Multifunctional Soft Materials and Structures: Modeling, Design and Validation
09:45	**Coffee**	**Break**
	Session Chair: ***Geoffrey Cranch (NRL)***	
10:00	**Rich Vaia** **Larry Drummy** AFRL/RX	Mechanically Adaptive Materials: Property Transformation via Continuous Transitions
10:25	**Anna Balazs** U Pittsburgh	Designing Sensory and Adaptive Composite Materials
10:50	**Eric Wetzel** **ARL/WMRD**	Design of 2D Organic Materials
11:15	**SungWoo Nam** U Illinois	Mechanical Instability-driven Architecturing of Atomically-thin Materials
11:40	**Lunch**	**Carry-in**

	Luncheon Talk - ***Moderator:*** ***Ignacio Perez (ONR)***	
11:55	**Boris Yakobson** Rice U	***Invited Review Lecture:*** "Low-D Materials: CNT, Graphene and Beyond -- Exploring Synthesis for Functionality"
	Session Chair: ***Ajit Roy (AFRL/RX)***	
13:00	**Ioannis Chasiotis** U Illinois	Design of Multifunctional Films for Compliant Interface
13:25	**Jim Thomas** NRL	Multifunctional Poro-Vascular Composites with Structure plus Surface Morphology Control
13:50	**Greg Ehlert** **Josh Kennedy** **Jeff Baur** AFRL/RX	Polymer Composites under Lasers Irradiation: Responsive Interfaces and Nano-scaled Internal Sensing

14:15	**Somnath Ghosh** Johns Hopkins U	An Integrated Spatio-Temporal Multi-Scale Computational Modeling System for Coupled Electromagnetics and Thermo-Mechanical Simulations with Damage in Multifunctional Materials
14:40	**Coffee**	**Break**
Session Chair: ***John Hart (MIT)***		
14:55	**John Hart** MIT	Fundamental Mechanics of Joints and Assemblies of Long Aligned Carbon Nanotubes
15:20	**Mark Schulz** **Vesselin Shanov** U Cincinnati	Carbon Nanotube Synthesis
15:45	**Sameh Tawfick** U Illinois	High Rate Synthesis of Infinitely Long Core-Shell Nickel Carbon Nanotube Fibers
16:10	**Ray Baughman** U Texas Dallas	High Performance Artificial Muscles Using Nanofiber and Hybrid Yarns
16:35		***Open Discussion***
17:00	**Adjournment**	**Adjournment**

Tuesday, August 29

Time	***Speaker***	***Title of Presentation***
08:00		***Housekeeping***
Session Chair: ***Rich Vaia (AFRL/RX)***		
08:05	**Keith Perkins** NRL	Carbon Nanotube-Based Sensor Platform
08:30	**Ben Dickinson** AFRL/RW **Jeff Baur** AFRL/RX **Greg Reich** AFRL/RQ	Embedded Carbon Nanotube-Based Airflow Sensors for Adaptive Air Systems
08:55	**Nanshu Lu** U Texas Austin	*(YIP)* Super-Expandable Adaptive Sensor Network (SEASN) Enabled by Piezoelectric Polymer Serpentines
09:20	**Fu-Kuo Chang** Stanford U	Self-Diagnostic Adhesive for Bonded Joints in Aircraft Structures
09:45	**Coffee**	**Break**
Session Chair: ***Kara Peters (North Carolina State U)***		
10:00	**Kara Peters** North Carolina State U	Increased Lamb Wave Detection Sensitivity of Surface Bonded Fiber Bragg Gratings through Bonding Optimization
10:25	**Geoffrey Cranch** NRL	Multiparameter Sensing Techniques for Structural Health Monitoring
10:50	**Sridhar Krishnaswamy** Northwestern U	Mesoscale Integrated Polymer Optical Microsensors for Strain and Chemical Sensing
11:15	**Ming Han** U Nebraska	Adaptive and Sensitive Fiber-Optic Sensor Systems for Detection of Acoustic Emissions
11:40	**Lunch**	**Carry-in**

Luncheon Talk - ***Moderator:*** ***Jim Thomas (NRL)***		
11:55	**Joseph Hays** NRL	***Briefing for NRL Program on Lightweight Architecture for Space Robotics:*** "Multifunctional Pneumatic Artificial Muscle (PAM) Actuators for Space Robotics Applications," *(PI:* ***Joseph Hays****, Lead Roboticist for MeRLIn: Meso-scale Robotic Locomotion Investigation Program, Naval Research Laboratory, Washington, DC)*
Session Chair: ***Victor Giurgiutiu (U South Carolina)***		
13:00	**Haiying Huang** U Texas Arlington	Simultaneous Strain and Temperature Measurement Using a Single Fiber Bragg Grating Embedded in Composite Laminate
13:25	**Victor Giurgiutiu** U South Carolina	Physics of Materials Based Predictive Methodology for Acoustic Emission Signals ID Validated by Experiments under Various Operational Condition
13:50	**Antonios Kontsos** Drexel U	*(YIP)* Identification of Fatigue Precursors for Multiscale NDE & Prognostics
14:15	**Mohammad Modarres** U Maryland	An Acoustic Emission Approach to Assess Remaining Useful Life of Aging Structures under Fatigue Loading
14:40	**Coffee**	**Break**
Session Chair: ***Shashank Priya (VA Tech)***		
14:55	**Shashank Priya** VA Tech	Self-Biased Dual Field Energy Harvesting System for Structural Health Monitoring Sensors
15:20	**Peter Finkel** NRL	Broad Band Energy Harvesting Utilizing Phase Transitions in Piezoelectric Single Crystals
15:45	**Gleb Yushin** GA Tech	Strong and Flexible Electrodes for Multifunctional Li-ion Batteries
16:10	**Nicholas Kotov** U Michigan	Nanocomposite Ion Conductors from Branched Aramid Nanofibers for Zn Thin Film Batteries
16:35		***Open Discussion***
17:00	**Adjournment**	**Adjournment**

Time	***Speaker***	***Title of Presentation***
Wednesday, August 30		
08:00		***Housekeeping***
Session Chair: ***Shawn Walsh (ARL)***		
08:05	**Les Lee** AFOSR **Ignacio Perez** ONR **David Stepp** ARO	***Welcome Remarks***
08:15	**Kenneth Church** nScrypt, Inc Sciperio, Inc.	***Keynote #2 –*** 3D Manufacturing of Multifunctional Devices
08:55	**Larry Holmes** ARL/WMRD	Additive Manufacturing for Multifunctionality: Materials Perspective

09:20	**Eric Wetzel** **Kevin Hart** ARL/WMRD	Manufacturing of Multifunctional Fiber Assemblies
09:45	**Coffee**	**Break**
Session Chair: ***Larry Holmes (ARL)***		
10:00	**Mike Durstock** **Dan Berrigan** **Benji Maruyama** AFRL/RX	3D Printing of Materials and Devices for Integrated Multifunctionality
10:25	**Jerry Qi** GA Tech **Kurt Maute** **Martin Dunn** U Colorado	4D Printed Composites for Topology-Transforming Multifunctional Devices
10:50	**Jennifer Lewis** Harvard U **Anna Balazs** U Pittsburgh **Ralph Nuzzo** U Illinois	4D Printing of Patterned Gels and Nanocomposites
11:15	**Dan Berrigan** **Phil Buskohl** AFRL/RX	3D Printed Soft Cellular Antennas to Couple Electromagnetic and Mechanical Design
11:40	**Lunch**	**Carry-in**

Luncheon Talk - ***Moderator:*** ***Mike Durstock (AFRL/RX)***		
11:55	**Jeff Baur** AFRL/RX	***Invited Lecture for AFRL Centennial Celebration:*** "Research Needs in Multifunctional Composites for Next Generation Air Vehicles: Air Force Perspective," ***Jeff Baur****, Principal Engineer, Composite Materials, Materials & Manufacturing Directorate, Air Force Research Laboratory, Wright-Patterson Air Force Base, Ohio*
Session Chair: ***Josh Kennedy (AFRL/RX)***		
13:00	**Austin Minnich** Caltech	Thermal Transport in Ultralight Multifunctional Nanolattices
13:25	**Abraham Stroock** Cornell U **Noel Holbrook** Harvard U	Plant-mimetic Heat Pipes for Operation with Large Inertial and Gravitational Stresses
13:50	**Jonathan Boreyko** VA Tech	*(YIP)* Planar Bridging-Droplet Thermal Diodes
14:15	**Chris Mangun** CU Aerospace **Alex Bogdanovich** North Carolina State U **Jeffrey Olson** Lockheed Martin Space	*(STTR Phase II)* Microvascular Composites for Novel Thermal Management Devices
14:40	**Coffee**	**Break**
Session Chair: ***Dan Berrigan (AFRL/RX)***		
14:55	**Guoliang Huang** U Missouri	Active Elastic Metamaterials with Controllable Effective Mass Densities

	C. T. Sun Purdue U	
15:20	**Massimo Ruzzene** **Alper Erturk** GA Tech **Paolo Ermanni** ETH Zürich	Damping, Design, Metamaterials
15:45	**Dan Inman** U Michigan	Electronic Damping in Multifunctional Material Systems
16:10	**Yakup Bayram** PaneraTech **Greg Carman** UCLA	*(STTR Phase II)* Multiferroic Small Antennas
16:35		***Open Discussion***
17:00	**Adjournment**	**Adjournment**

Thursday, August 31		
Time	***Speaker***	***Title of Presentation***
08:00		***Housekeeping***
Session Chair: ***Jeff Baur (AFRL/RX)***		
08:05	**David Kisailus** UC Riverside **Pablo Zavattieri** Purdue U	Damage-tolerant Biological Composites Derived from the Teeth of a Giant Chiton
08:30	**Majid Minary-Jolandan** U Texas Dallas	*(YIP)* Lessons from Bone to Bio-inspired Tough and Self-Remodeling Aerospace Materials
08:55	**Nancy Sottos** U Illinois	Multifunctional Damage Tolerant Composite Materials
09:20	**Chris Tabor** AFRL/RX	Room Temperature Liquid Metal Colloidal Suspensions for Self-Healing and Resilient Electronics
09:45	**Coffee**	**Break**
Session Chair: ***Chris Tabor (AFRL/RX)***		
10:00	**Jeffrey Moore** U Illinois	*(CoE)* Self-Healing, Regeneration & Structural Remodeling: Transformational Chemistries
10:25	**Philippe Geubelle** U Illinois	*(CoE)* Self-Healing, Regeneration & Structural Remodeling: Modeling of Rapid Polymerization Fronts
10:50	**Scott White** U Illinois	*(CoE)* Self-Healing, Regeneration & Structural Remodeling: Transient Materials to 4D Printing for Multifunctional Composites
11:15	**Nancy Sottos** U Illinois	*(CoE)* Self-Healing, Regeneration & Structural Remodeling: Characterization and Analysis of Autonomic Composites
11:40	**Lunch**	**Carry-in**

Luncheon Break - ***Moderator:*** ***Stephanie McElhinny (ARO)***		
11:55	**David Kovar** U Chicago	***Briefing on ARO MURI '14:*** "Mechanisms of Force Sensing in Adherent Cells as Inspiration for New Materials" *(3rd Annual Review in Arlington, VA on March 9, 2017;* ***U Chicago /***

		***Yale U / ETH Zürich**; PI: **Margaret Gardel**; Co-PI's: **David Kovar**, **Gregory Voth**, **Enrique De La Cruz**, **Martin Schwartz**, **Michael Murrell**, **Eric Dufresne**) (PM: **Stephanie McElhinny**; Co-PM: **David Stepp**)*
Session Chair:** **Greg Ehlert (AFRL/RX)		
13:00	**Aaron Esser-Kahn** UC Irvine	*(CoE)* Self-Healing, Regeneration, and Structural Remodeling: Vascular Remodeling and Morphogenic Adaptation
13:25	**Ximin He** UCLA	*(YIP)* Bio-inspired Artificial Homeostatic Multifunctional Material Microsystems (AHM3)
13:50	**Yuhang Hu** U Illinois	*(YIP)* Tough Gel: A Perfect Platform for Designing Chemo-Mechano-Chemically Responsive Multi-Functional Materials
14:15	**Aaron Esser-Kahn** U Chicago	*(PECASE)* Sensing and Modulating Materials Properties Using Piezo-Electric Response Elements
14:40	**Coffee**	**Break**
Session Chair:** **Keith Perkins (NRL)		
14:55	**Don Leo** U Georgia	*(BRI'12)* Autonomic Biomolecular Materials for Sensing, Actuation, and Energy Conversion: Tailoring Mechanosensitive Response
15:20	**Andy Sarles** U Tennessee	*(BRI'12)* Autonomic Biomolecular Materials for Sensing, Actuation, and Energy Conversion: Stimuli Responsive Unit Cells and Assemblies
15:45	**Sergei Sukharev** U Maryland	*(BRI'12)* Autonomic Biomolecular Materials for Sensing, Actuation, and Energy Conversion: Functionality of Biological Molecules
16:10	**Narayan Aluru** U Illinois	*(BRI'12)* Autonomic Biomolecular Materials for Sensing, Actuation, and Energy Conversion: Multiscale Simulations
16:35		***Open Discussion***
17:00	**Adjournment**	**Adjournment**

Friday, September 1		
Time	***Speaker***	***Title of Presentation***
08:00		***Housekeeping***
Session Chair:** **Jay Kudva (NextGen Aeronautics)		
08:05	**Christopher Kroninger** **Geoff Slipher** **Aaron Harrington** ARL/VTD	Wing Span Adaptation Enabled through Electro-Active Skins and Embodied Intelligence
08:30	**James Joo** AFRL/RQ	*(Invited from 3002D)* Variable Camber Compliant Wing (VCCW)
08:55	**Jonathan Hopkins** UCLA	Design of Actively Controlled Microarchitectures with Programmable Mechanical Properties
09:20	**Nicolaus Correll** U Colorado	Distributed Algorithms for Stiffness and Shape Changing Computational Meta-Materials
09:45	**Coffee**	**Break**

Session Chair: *Ben Dickinson (AFRL/RW)*		
10:00	**Robert Shepherd** Cornell U	*(YIP)* Co-Continuous Metal-Elastomer Foam Actuators for Morphing Wing Micro Air Vehicles
10:25	**Rebecca Kramer** Purdue U	*(YIP)* Robotic Fabrics: Multifunctional Fabrics for Reconfigurable and Wearable Soft Systems
10:50	**Greg Reich** **Philip Beran** AFRL/RQ	Bio-inspired Reconfigurable System Design via Topology Optimization
11:15	**Yong Chen** UCLA	Neuromorphic Network Based on Carbon Nanotube/Polymer Composite
11:40	**Lunch**	**Carry-in**

Luncheon Talk - *Moderator: Greg Reich (AFRL/RQ)*		
11:55	**Dan Inman** U Michigan **David Lentink** Stanford U	***Briefing on AFOSR Basic Research Initiative '16:*** "Avian-Inspired Multifunctional Morphing Vehicles" *(1st Annual Review at Royal Veterinary College, London, UK on March 16-17, 2017;* ***U Michigan / Stanford U / UCLA / Texas A&M / U British Columbia / Royal Veterinary College / U Rome / ETH Zürich****) (PI:* ***Daniel Inman****; Co-PIs:* ***Henry Sodano, David Lentink, Fu-Kuo Chang, Yong Chen, Darren Hartl, Douglas Altshuler, , Richard Bomphrey, Jim Usherwood, Giulia Lanzara, Walter Lacarbonara, Andre Studart****) (PM:* ***Les Lee****; Co-PM's:* ***Douglas Smith, Patrick Bradshaw, Russell Cummings, David Garner****)*

Session Chair: *Christopher Kroninger (ARL)*		
13:00	**Andres Arrieta Diaz** Purdue U	*(Co-sponsored by 3002D)* On-demand Stiffness Selectivity for Morphing Systems
13:25	**Hugh Bruck** U Maryland **Satyandra Gupta** U Southern Calif	Principles for Designing Compliant Multifunctional Wing Structures with Integrated Solar Cells for Micro Air Vehicles
13:50	**Jay Kudva** Concepts to Systems **Geoffrey Spedding** U Southern Calif **Roy Kornbluh** SRI International	*(STTR Phase II)* Biomimetic Design of Morphing Micro Air Vehicles
14:15	**Harry Perkinson** TRI Austin **Peter Ifju** U Florida	*(STTR Phase II)* Biomimetic Design of Morphing Micro Air Vehicles *– to be confirmed*
14:40	**Les Lee** AFOSR **Ignacio Perez** ONR **David Stepp** ARO	***Closing Remarks***
15:00	**Adjournment**	**Adjournment**

MAIN WEBSITE

https://community.apan.org/wg/afosr/w/researchareas/19417/2017-annual-grantees-contractors-meeting-for-afosr-mechanics-of-multifunctional-materials-and-microsystems-m-4-program-and-the-4th-multifunctional-materials-for-defense-workshop

Including the information on the meeting registration, agenda, hotels and parking

MEETING SITE

Basic Research Innovation & Collaboration Center (BRICC)

Liberty Room on the 3rd Floor

4075 Wilson Boulevard, Arlington, VA 22203

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ONR Program on "Structural Composites & Non-Destructive Evaluation"
(# Not presenting at the Workshop)

PO: Ignacio Perez de Leon

Boris Yakobson (Rice Univ.) "Computing the CNT Lengths: Growth Limits vs. the Assemblies-Strength Optima"

SungWoo Nam (Univ. of Illinois) "*(YIP)* Mechanical Instability-driven Architecturing of Atomically-thin Materials"

Anastasios John Hart (Massachusetts Inst. of Technology) "Fundamental Mechanics of Joints and Assemblies of Long Aligned Carbon Nanotubes"

Mark Schulz (Univ. of Cincinnati) "Carbon Nanotube Synthesis"
+Vesselin Shanov (Univ. of Cincinnati)

#Kirk Ziegler (Univ. of Florida) "Continuous Growth of Carbon Nanotubes Using Anodic Alumina Templates"

Sameh Tawfick (Univ. of Illinois) "High Rate Synthesis of Infinitely Long Core-Shell Nickel Carbon Nanotube Fibers"

Keith Perkins (Naval Research Lab) "Carbon Nanotube-Based Sensor Platform"

Antonios Kontsos (Drexel Univ.) "*(YIP)* Identification of Fatigue Precursors for Multiscale NDE & Prognostics"

Antonios Kontsos (Drexel Univ.) "Novel Acoustics-based Framework for Structural Health Monitoring of Navy Assets"

Victor Giurgiutiu (Univ. of South Carolina) "Physics of Materials Based Predictive Methodology for AE Signals ID Validated by Experiments under Various Operational Condition"

Victor Giurgiutiu (Univ. of South Carolina) "A New Generation of Acoustic Emission Smart Sensors"

Sridhar Krishnaswamy (Northwestern Univ.) "All-Fiber Adaptive Two-Wave Mixing Demodulator and Adaptive 1064nm Fiber Laser Source for Fiber-Bragg Grating Sensors"

Ming Han (Univ. of Nebraska) "Adaptive and Sensitive Fiber-Optic Sensor Systems for Detection of Acoustic Emissions"

Ming Han (Univ. of Nebraska) "Fiber-Ring Laser Acoustic Emission Sensors for Structural Health Monitoring"

Geoffrey Cranch (Naval Research Lab) "Multiparameter Sensing Techniques for Structural Health Monitoring"

Geoffrey Cranch (Naval Research Lab) "High Frequency Structural Monitoring via Multiplexed Fiber Lasers"

Kara Peters (North Carolina State Univ.) "Increased Lamb Wave Detection Sensitivity of Surface Bonded Fiber Bragg Gratings through Bonding Optimization"

Haiying Huang (Univ. of Texas at Arlington) "Simultaneous Strain and Temperature Measurement Using a Single Fiber Bragg Grating Embedded in Composite Laminate"

Mohammad Modarres (Univ. of Maryland) "An Acoustic Emission Approach to Assess Remaining Useful Life of Aging Structures under Fatigue Loading"

Shashank Priya (Virginia Polytechnic Inst.) "Self-Biased Dual Field Energy Harvesting System for Structural Health Monitoring Sensors"

Peter Finkel (Naval Research Lab) "Broad Band Energy Harvesting utilizing Phase Transitions in Piezoelectric Single Crystals"

The 2017 Annual Grantees'/Contractors' Meeting for AFOSR Program on "Mechanics of Multifunctional Materials & Microsystems"

(# Not presenting at the Workshop)

PO: B.-L. ("Les") Lee

Liping Liu (Rutgers Univ.) "Multifunctional Soft Materials and Structures: Modeling, Design and Validation"

Richard Vaia (Air Force Research Lab - AFRL/RXA) "Mechanically Adaptive Materials: Property Transformation via Continuous Transitions"

+Larry Drummy (Air Force Research Lab - AFRL/RXAS)

Anna Balazs (Univ. of Pittsburgh) "Designing Sensory and Adaptive Composite Materials"

Ioannis Chasiotis (Univ. of Illinois) "Design of Multifunctional Films for Compliant Interface"

James Thomas (Naval Research Lab) "Multifunctional Poro-Vascular Composites with Structure plus Surface Morphology Control"

Gregory Ehlert (Air Force Research Lab - AFRL/RXCCM) "Polymer Composites under Lasers Irradiation: Responsive Interfaces and Nano-scaled Internal Sensing"

+W. Joshua Kennedy (Air Force Research Lab - AFRL/RXCCM)

+Jeffery Baur (Air Force Research Lab - AFRL/RXCCM)

Somnath Ghosh (Johns Hopkins Univ.) "An Integrated Spatio-Temporal Multi-Scale Computational Modeling System for Coupled Electromagnetics and Thermo-Mechanical Simulations with Damage in Multifunctional Materials"

Ray Baughman (Univ. of Texas at Dallas) "Twist-Spun Polymer and Nanotube Artificial Muscle Fibers and Yarns"

Benjamin Dickinson (Air Force Research Lab - AFRL/RWWN) " Embedded Carbon Nanotube-Based Airflow Sensors for Adaptive Air Systems"

+Jeffery Baur (Air Force Research Lab - AFRL/RXCCM)

+Gregory Reich (Air Force Research Lab - AFRL/RQVC)

Nanshu Lu (Univ. of Texas at Austin) "*(YIP)* Super-Expandable Adaptive Sensor Network (SEASN) Enabled by Piezoelectric Polymer Serpentines"

Fu-Kuo Chang (Stanford Univ.) "Self-Diagnostic Adhesive for Bonded Joints in Aircraft Structures"

#Akira Todoroki (Tokyo Inst. of Technology) "Addressable Conducting Network for Composite Structures"

Gleb Yushin (Georgia Inst. of Technology) "Strong and Flexible Electrodes for Multifunctional Li-ion Batteries"

Nicholas Kotov (Univ. of Michigan) "Nanocomposite Ion Conductors from Branched Aramid Nanofibers for Zn Thin Film Batteries"

#Emile Greenhalgh (Imperial College London) "Damage Tolerance and Durability of Structural Power Composites" *(Co-PM: B.-L. ("Les") Lee; PM: Mitat Birkan)*

+Leif Asp (Chalmers Univ. of Technology)

+Dan Zenkert (KTH Royal Institute of Technology)

Michael Durstock (Air Force Research Lab - AFRL/RXAS) "3D Printing of Materials and Devices for Integrated Multifunctionality"

+Dan Berrigan (Air Force Research Lab - AFRL/RXAS)

+Benji Maruyama (Air Force Research Lab - AFRL/RXAS)

Jerry Qi (GA Tech) "Multifunctional Devices enabled by 4D Hybrid Printing"

+Kurt Maute (Univ. of Colorado)

+Martin Dunn (Singapore Univ. of Technology and Design)

#Richard Trask (Univ. of Bath) "4D Programmed Stimuli-Responsive Structural Reinforcement"

Austin Minnich (California Inst. of Technology) "Investigation of Thermal Transport in Ultralight Multifunctional Nanolattices"

Abraham Stroock (Cornell Univ.) "Plant-Mimetic Functional Materials for Thermal Management and Suppression of Freezing"

+Noel Holbrook (Harvard Univ.)

#Aaron Esser-Kahn (Univ. of California, Irvine) "Adaptable Materials to Improve Thermal Transport"

Jonathan Boreyko (Virginia Polytechnic Inst.) "*(YIP)* Planar Bridging-Droplet Thermal Diodes"

Chris Mangun (CU Aerospace, Inc.) "*(STTR Ph II)* Microvascular Composites for Novel Thermal Management Devices"
+Philippe Geubelle (Univ. of Illinois)
+Scott White (Univ. of Illinois)
+Alexander Bogdanovich (North Carolina State Univ.)
+Jeffrey Olson (Lockheed Martin Space Systems Co.)

#Walter Lacarbonara (Univ. of Rome) "Bridging High Strength and Dissipation in Carbon Nanotube Composites"
Guoliang Huang (Univ. of Missouri) "Active Elastic Metamaterials with Controllable Effective Mass Densities"
+C. T. Sun (Purdue Univ.)
Massimo Ruzzene (Georgia Inst. of Technology) "Damping, Design, Metamaterials"
+Alper Erturk (Georgia Inst. of Technology)
+Paolo Ermanni (ETH Zürich)
Daniel Inman (Univ. of Michigan) "Electronic Damping in Multifunctional Material Systems"

#Ajit Roy (Air Force Research Lab - AFRL/RXAN) "Integrated Circuits & Electronics for Extreme Environments"
+Jason Foley (Air Force Research Lab - AFRL/RWMFS)
+Amanda Schrand (Air Force Research Lab - AFRL/RWMF)
#Thomas Reitz (Air Force Research Lab - AFRL/RQQM) "High-Performance 3-Dimensional Electrical Interfaces"
+Kevin Yost (Air Force Research Lab - AFRL/RQQM)
#Gregory Huff (Texas A&M Univ.) "Multifunctional Material Systems for Reconfigurable Antennas"
+Zoubeida Ounaies (Pennsylvania State Univ.)
+Michael Bevan (Johns Hopkins Univ.)
Yakup Bayram (PaneraTech, Inc.) "*(STTR Ph II)* Multiferroic Small Antennas"
+Gregory Carman (Univ. of California, Los Angeles)

David Kisailus (Univ. of California, Riverside) "Damage-tolerant Bio-composites Derived from Teeth of Giant Chiton"
+Pablo Zavattieri (Purdue Univ.)
Majid Minary-Jolandan (Univ. of Texas at Dallas) "*(YIP)* Lessons from Bone to Bio-inspired Tough and Self-Remodeling Aerospace Materials"
Nancy Sottos (Univ. of Illinois) "Multifunctional Damage Tolerant Composite Materials"
Christopher Tabor (Air Force Research Lab - AFRL/RXAN) "Room Temperature Liquid Metal Colloidal Suspensions for Self-Healing and Resilient Electronics"
Jeffery Moore (Univ. of Illinois) "*(CoE)* Self-Healing, Regeneration, and Structural Remodeling: Transformational Chemistries"
Philippe Geubelle (Univ. of Illinois) "*(CoE)* Self-Healing, Regeneration, and Structural Remodeling: Modeling of Rapid Polymerization Fronts"
Scott White (Univ. of Illinois) "*(CoE)* Self-Healing, Regeneration, and Structural Remodeling: Transient Materials to 4D Printing for Multifunctional Composites"
Nancy Sottos (Univ. of Illinois) "*(CoE)* Self-Healing, Regeneration, and Structural Remodeling: Characterization and Analysis of Autonomic Composites"
Aaron Esser-Kahn (Univ. of California, Irvine) "*(CoE)* Self-Healing, Regeneration, and Structural Remodeling: Vascular Remodeling and Morphogenic Adaptation"
Ximin He (Univ. of California, Los Angeles) "*(YIP)* Bio-inspired Artificial Homeostatic Multifunctional Material Microsystems (AHM3)"
Yuhang Hu (Univ. of Illinois) "*(YIP)* Tough Gel: A Perfect Platform for Designing Chemo-Mechano-Chemically Responsive Multi-Functional Materials"
Aaron Esser-Kahn (Univ. of California, Irvine) "*(PECASE)* Sensing and Modulating Materials Properties Using Piezo-Electric Response Elements"
#Haiwon Lee (Hanyang Univ.) "Template Effect on Guiding Biomolecular Growth by 3-D CNT Networks"

Donald Leo (Univ. of Georgia) "*(BRI'12)* Autonomic Biomolecular Materials for Sensing, Actuation, and Energy Conversion: Tailoring Mechanosensitive Response"
Andy Sarles (Univ. of Tennessee) "*(BRI'12)* Autonomic Biomolecular Materials for Sensing, Actuation, and Energy Conversion: Stimuli Responsive Unit Cells and Assemblies"

Sergei Sukharev (Univ. of Maryland) “*(BRI’12)* Autonomic Biomolecular Materials for Sensing, Actuation, and Energy Conversion: Functionality of Biological Molecules”

Narayan Aluru (Univ. of Illinois) “*(BRI’12)* Autonomic Biomolecular Materials for Sensing, Actuation, and Energy Conversion: Multiscale Simulations”

James Joo (Air Force Research Lab - AFRL/RQVC) “Variable Camber Compliant Wing (VCCW)”

Jonathan Hopkins (Univ. of California, Los Angeles) "Design of Actively Controlled Microarchitectures with Programmable Mechanical Properties"

Nikolaus Correll (Univ. of Colorado) "Distributed Algorithms for Stiffness and Shape Changing Computational Meta-Materials"

Robert Shepherd (Cornell Univ.) "*(YIP)* Co-Continuous Metal-Elastomer Foam Actuators for Morphing Wing Micro Air Vehicles"

Rebecca Kramer (Purdue Univ.) "*(YIP)* Robotic Fabrics: Multifunctional Fabrics for Reconfigurable and Wearable Soft Systems"

Gregory Reich (Air Force Research Lab - AFRL/RQVC) "Bio-inspired Reconfigurable System Design via Topology Optimization"

+Philip Beran (Air Force Research Lab - AFRL/RQVC)

Yong Chen (Univ. of California, Los Angeles) "Intelligent Neuromorphic Network Based on Carbon Nanotube/Polymer Composite"

Daniel Inman (Univ. of Michigan) "*(BRI’16)* Avian-Inspired Multifunctional Morphing Vehicles"

Henry Sodano (Univ. of Michigan) "*(BRI’16)* ….”

Fu-Kuo Chang (Stanford Univ.) "*(BRI’16)* ….”

Yong Chen (Univ. of California, Los Angeles) "*(BRI’16)* ….”

Darren Hartl (Texas A&M Univ.) "*(BRI’16)* ….”

David Lentink (Stanford Univ.) "*(BRI’16-a)* Principles of Avian Musculoskeletal Control for Multifunctional Morphing Vehicle"

Douglas Altshuler (Univ. of British Columbia) "*(BRI’16-a)* ….”

#Richard Bomphrey (Royal Veterinary College) "*(BRI’16-b)* Avian-Inspired Multifunctional Morphing Air Vehicles: Underpinning Biological Research"

+Jim Usherwood (Royal Veterinary College)

#Giulia Lanzara (Univ. of Rome) "*(BRI’16-c)* Phase-changing Morphing Metamaterial with Hierarchical Muscular Skeletal Structure"

+Walter Lacarbonara (Univ. of Rome)

#Andre Studart (ETH Zürich) "*(BRI’16-d)* Fast Morphing Multi-stable Structures Made from Shape Programmable Bio-inspired Composites"

Andres Arrieta Diaz (Purdue Univ.) "On-demand Stiffness Selectivity for Morphing Systems" *(Co-PM: B.-L. (“Les”) Lee; PM: Jay Tiley)*

Hugh Bruck (Univ. of Maryland) "Compliant Multifunctional Skin Materials for Harvesting and Utilizing Solar Energy in Aerospace Applications"

+Satyandra Gupta (Univ. of Southern California)

Jay Kudva (Concepts to Systems, Inc.) "*(STTR Ph II)* Biomimetic Design of Morphing Micro Air Vehicles "

+Geoffrey Spedding (Univ. of Southern California)

+Roy Kornbluh (SRI International)

Harry Perkinson (Texas Research Inst. Austin, Inc.) "*(STTR Ph II)* Biomimetic Design of Morphing Micro Air Vehicles "

+Peter Ifju (Univ. of Florida)