Dynamic Data Driven Applications Systems (DDDAS)

Erik Blasch
eerik.blasch@gmail.com

www.1dddas.org

DDDAS Conference
02 Oct 2020
Outline

- DDDAS
  - Many application areas
  - Enables Autonomy

- Handbook 2018
  - Systems Approach
  - Enables Awareness

- Dynamic Data Driven Applications Systems
  - Awareness

- Conf Agenda

- Future
DDDAS Impacts (Autonomy)

Air

Space

Sensing

Information

Avionics

Cyber

Land

Networks
### DDDAS Literature Review


#### DDDAS Methodology to support Multi-Domain Operations

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<th>Monitoring</th>
<th>Data Fusion</th>
<th>Application</th>
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<td>Architecture Design</td>
<td>(Cyber) Network Trust</td>
<td>Energy Analysis</td>
<td>Image Computing</td>
<td>(Cyber) Micro-Grids</td>
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</table>

![Data Assimilation](image1.png)

- High-fidelity Models
- Reduced-Order Modeling
- Nonlinear Estimation

![Context Awareness](image2.png)

- Sensor Processing & Mgt
- Self-healing Systems
- Autonomous Robotics

![Data Flow Design](image3.png)

- Cybersecurity
- Energy/Power Grids
- Agile, Multi-domain Sys

![DDDAS Papers Per Year](image4.png)

- 2002
- 2007
- 2012
- 2017

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DDDAS (Awareness)


**Measurement Aware**
- Uncertainty Quantification

**Signals Aware**
- Process Monitoring

**Structures Aware**
- Health Modeling

**Context Aware**
- Coordinated Control

**Situation Aware**
- Target Tracking

**Space Aware**
- Atmosphere Modeling

**Energy Aware**
- Power Computing

**Cyber Aware**
- Security Analysis

**Process Aware**
- Scene modeling

**Systems Aware**
- Design
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Handbook of DDDAS
(System Aware - Design)

Measurement Aware
Signals Aware
Structures Aware

Context Aware
Situation Aware
Space Aware

Cyber/Info Aware
Energy Aware
Process Aware

Autonomy in MOTION
Autonomy in USE
Autonomy at REST

Dynamic Data Driven Application Systems

DDDAS Methodology to support Autonomy

- Measurements
- Methods
- Modeling

Sensor

Machine

Mission

Sensing Measurements → Statistical Learning → Modeling Updates

(ML) Run Time Architecture

- Instrumentation Control
- Algorithms Selection

(AI) Batch Mode Analysis

- Model Analysis
- Adversarial Learning

Situation Simulation

- User Refinement
- Operating Conditions

Agenda

• **October 2**
  – Section 1: Digital Twins
  – Section 2: Environment Cognizant Adaptive-Planning Systems
  – Section 3: Energy Systems
  – Section 4: Materials Systems
  – Posters Session-1: Sensing

• **October 3**
  – Section 5: Physics-based Systems Analysis
  – Section 6: Imaging Methods and Systems
  – Section 7: Learning Systems
  – **Industry Panel -1**: Impact of DDDAS/InfoSymbiotics in the Industrial Sector
  – Posters Session-2: Autonomy

• **October 4**
  – **IndustryPanel-2**: AI/ML Applications for Aerospace and Defense
  – **Federal Agencies Panel**: Future Direction of DDDAS/InfoSymbiotics
DDDAS Conf 2020

• Organized Developments

- Materials Systems
- Imaging Methods
- BioInfo Sciences
- Learning Systems
- Cyber Infrastructure
- Autonomy AI
- Sensing Systems
- Adaptive Planning
- Energy Systems
- Digital Twin Engineering

Future Directions

Keynotes
Papers
Posters

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