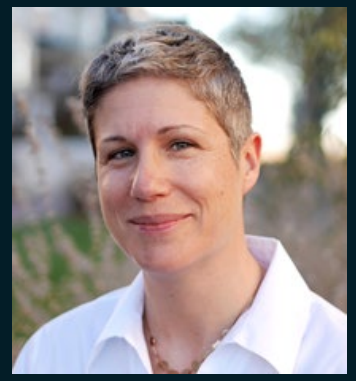
ACADEMIA & INDUSTRY COLLABORATION:

PREPARING STUDENTS FOR CAREERS IN ENGINEERING SIMULATION

HOSTED BY NAFEMS AMERICAS

Georgia Tech's Aerospace Systems Design Laboratory – Developing the Next Generation Workforce through Industry Collaboration

Prof. Dimitri Mavris,
Regent's Professor & Director,
Aerospace Systems Design Laboratory (ASDL),
School of Aerospace Engineering,
Georgia Institute of Technology



Dr. Olivia Pinon Fischer,
Digital Engineering Division Chief,
Senior Research Engineer,
Aerospace Systems Design Laboratory (ASDL),
School of Aerospace Engineering,
Georgia Institute of Technology

ASDL At-A-Glance

- Established in 1992 as a center for multi-disciplinary design and optimization, systems engineering, and technology assessments
- Mission is to be educational leader in advanced systems architecting, engineering, design, integration and operations, decision making, digital engineering, data and visual analytics
- Has extensive research capabilities, resources, and state-of-the-art facilities
- Performs research for government agencies and industry organizations around the globe
- Widely recognized for graduate education and research in systems engineering and vehicle design
- 1,150 degrees conferred to ASDL students since 1997
  - 250 PhDs
  - 900 MS degrees

Georgia Tech Aerospace Systems Design Laboratory

ASDL in Georgia Tech Organization

- Georgia Tech is divided into a set of Academic Units and the Georgia Tech Research Institute (GTRI)
- There are 6 colleges within Georgia Tech, with each having a number of individual schools
- ASDL plays the role of system integrator campus-wide

Georgia Tech Aerospace Systems Design Laboratory

ASDL Organizational Structure

Research Management
Neil Weston, Chief Engineer
Megan Scheidt, Research Portfolio Manager
Angela Steltzer, Project Initiation Manager

Director
Dimitri Mavris

Operations Management
Tanya Ard-Smith, Business Operations Manager
Adrienne Durham, Academic Affairs Manager
Christina Phillips, Finance Manager

6 Divisions
40 Branches
50 Research Engineers
100 Undergrads
200 Masters & PhD Students

25 Senior Graduate Researchers + **70** Graduate Researchers + **55** Graduate Research Associates + **50** Graduate Research Assistants

Advanced Configurations
Division Chief: Jimmy Tai

- Flight Physics
- Systems Analysis
- Subsonic Configurations
- Supersonic Configurations
- VTOL Configurations

Advanced Methods
Division Chief: Elena Garcia

- Model Based Systems Engineering
- Large Scale Optimization
- Extensions to Surrogate Modeling
- System Design Methods
- Uncertainty Quantification
- Strategic Planning
- Decision Science
- Production Analytics

Civil Aviation Research
Division Chief: Michelle Kirby

- Commercial Fleet Ops & Forecasting
- Green Energy & Sustainable Aviation
- Aviation Environmental Policy
- Airline Operations
- Air Traffic Control & Management
- Aviation Transportation SoS
- Aviation Safety and Certification
- UAS Operations Research

Digital Engineering
Division Chief: Olivia Fischer

- Digital Intelligence
- Living Habitats & Smart Cities
- Digital Infrastructure & Sustainability
- Machine Learning & Artificial Intelligence

Defense & Space
Division Chief: Alicia Sudol

- Military Operations & Logistics
- Military System of Systems
- Space Transportation System
- SoS Space Architectures
- Space Logistics
- Defense Acquisition
- Naval Systems
- Rocket Based Propulsion
- Hypersonics & Missiles Systems

Propulsion & Energy
Division Chief: Jon Gladin

- Aerothermo-mechanical Design
- Terrestrial Power Systems
- Subsystems & Aeropower
- Electrification
- Fuels & Emissions
- Controls & Operability

Experimental Facilities

ADEPT | Drone-X | Design, Build, Fly Lab | MakerSpace Lab

Other Locations

ASDL@ GT Lorraine (France) | ASDL@ NIA (Langley)

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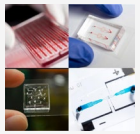
GT Interdisciplinary Research Institutes

Georgia Tech is home to ***11 academic Interdisciplinary Research Institutes (IRIs)*** responsible for bringing together a mix of researchers – spanning colleges, departments, and individual labs – around a single core research area. IRIs also connect a large portfolio of basic and applied research programs, support world-class research facilities and laboratories, engage Georgia Tech students, and collaborate with government and industry research partners.

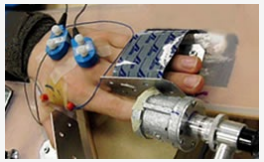
Institute for Electronics and Nanotechnology

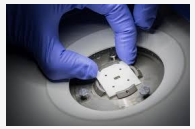


Institute of Data Engineering and Science

Strategic Energy Institute

Parker H. Petit Institute for Bioengineering & Bioscience





Institute for Materials

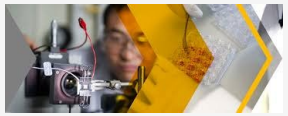
Institute for Robotics and Intelligent Machines

Renewable Bioproducts Institute

Institute for Information Security and

Institute for People and Technology

Brook Byers Institute for Sustainable



Manufacturing Institute

Georgia Tech Aerospace Systems Design Laboratory

The ASDL Vision

- In a broad sense, the basic aim of current and future research at ASDL is to be an **educational leader** in advanced systems architecting, engineering, design, integration and operations, decision making, digital engineering, data and visual analytics

- ASDL aims to accomplish this by fulfilling several roles:
  - **Develop the next generation** of highly qualified engineers for academia, industry, and government
  - **Develop cutting edge** multi-disciplinary, physics-based methods suitable for the design of all types of complex systems and systems of systems
  - **Provide independent and credible assessment capabilities** using integrated, quantifiable methodologies to government, and industry
  - Recent research focuses on combining ASDL's signature methods with advances in computing to enable **large-scale virtual experimentation for complex systems design**

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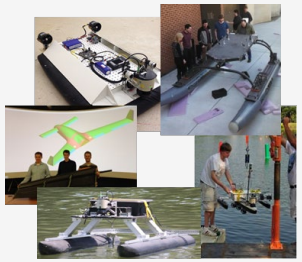
Facilities

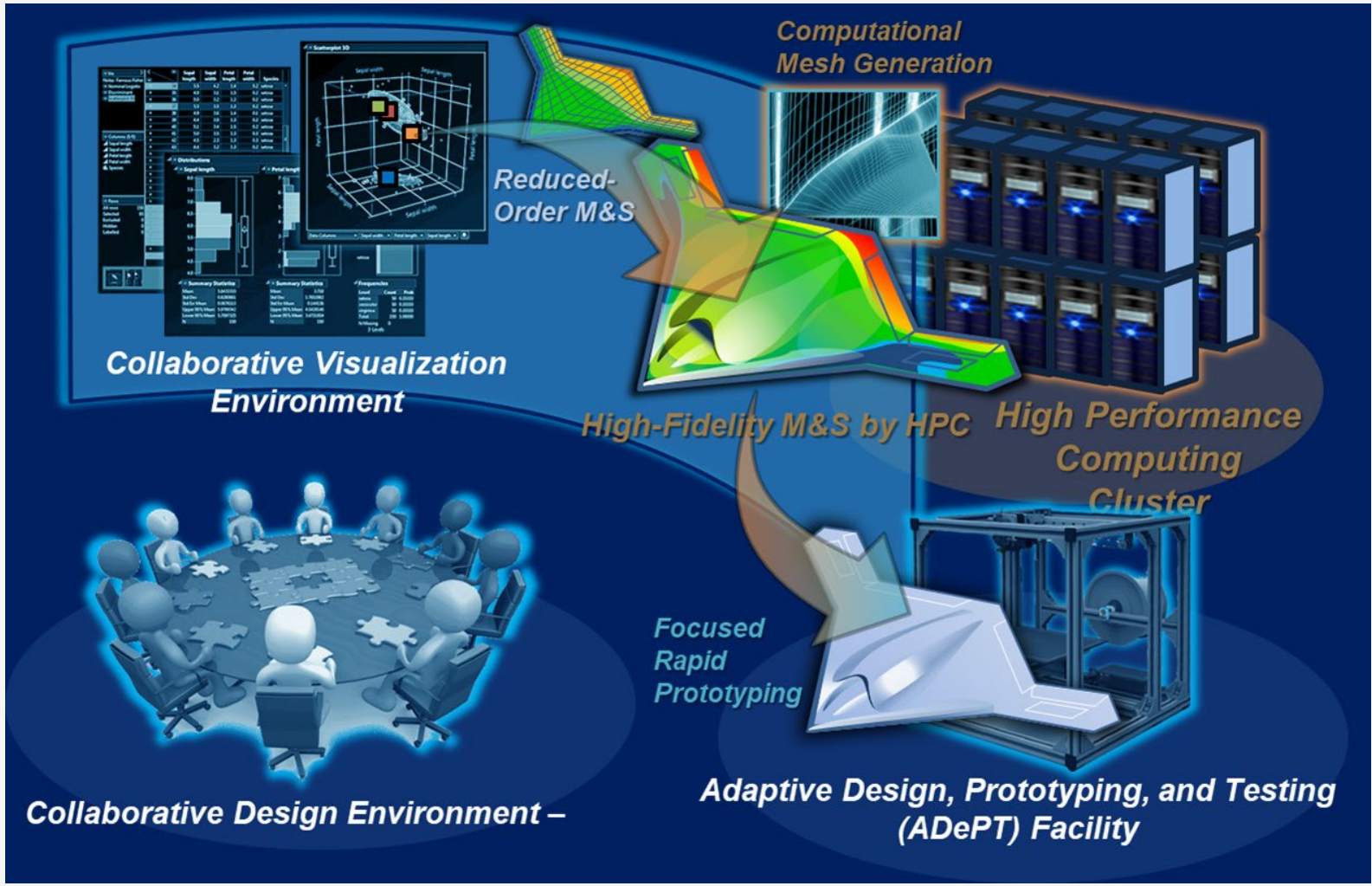
Collaborative Visualization Environment (CoVE) – 2004/2010/2018

Collaborative Design Environment (CoDE) – 2009/2021



Adaptive Design, Prototyping, and Testing (ADePT) Facility - 2013

Design, Build, Fly Laboratory



ONR DURIP Facilities for Virtual Experimentation

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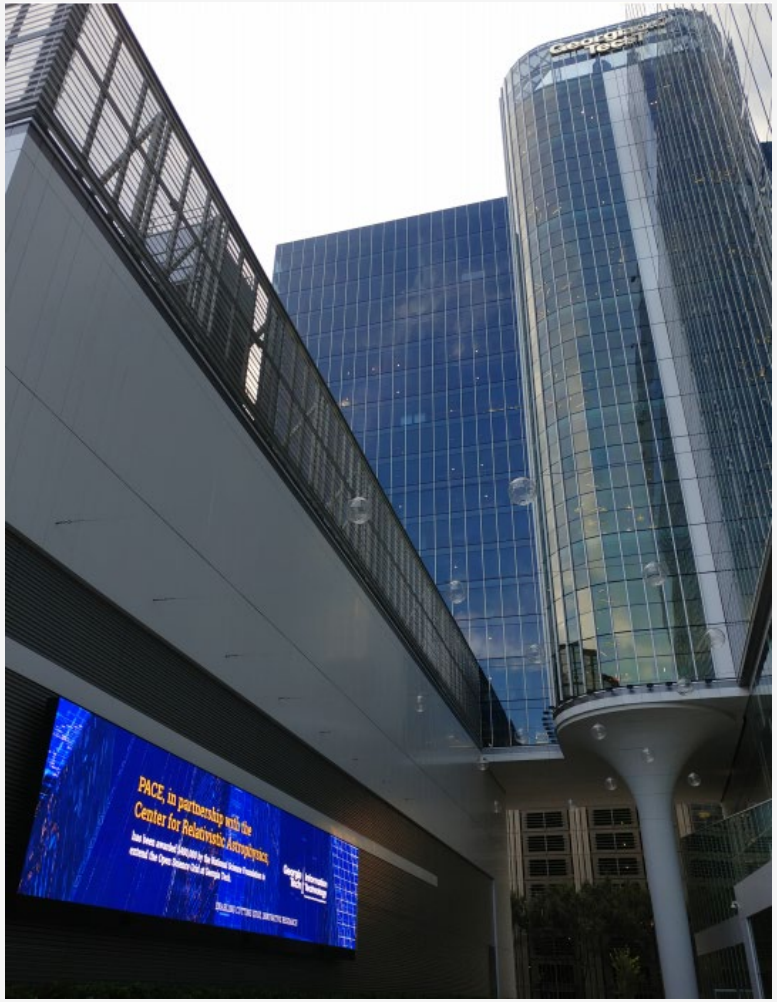
Georgia Tech High Performance Computing

- Georgia Tech has an Institute-Wide focus on HPC
  - New CODA building with state-of-the-art datacenter
  - Georgia Tech's Phoenix Cluster is ranked #277 in the November 2020 Top 500 list
    - 31,104 Intel Cascade Lake compute cores
    - 1.8 petaflops
    - Contains Nvidia RTX6000 and V100 GPUs
- CUI and ITAR computing (Firebird Cluster)
  - GT's Firebird cluster is NIST 800-171 compliant
- Georgia Tech provides this capability to faculty at a subsidized rate
  - CPU and GPUs available on a per-hour cost basis
  - Similar model to Amazon's Elastic Compute Cloud (EC2)



Georgia Tech Aerospace Systems Design Laboratory

Modes of Engagement with Industry

- Sponsored Research
- Centers of Excellence, Strategic Alliances, Fellowships
- Grand Challenges
- Professional Master's in Applied Systems Engineering

Georgia Tech Aerospace Systems Design Laboratory

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Our Sponsors – Worldwide Support

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SIKORSKY A LOCKHEED MARTIN COMPANY
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Triumph Group
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DELTA
RICARDO
Raytheon

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Modes of Engagement with Industry

- Sponsored Research
- **Centers of Excellence, Strategic Alliances, Fellowships**
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Strategic Alliances

Centers of Excellence

Supported by Advanced Configurations, Civil Aviation Research, and Propulsion & Energy Divisions

ASCENT AVIATION SUSTAINABILITY CENTER

FAA Center of Excellence for Alternative Jet Fuels & Environment

PEGASAS

Supported by Advanced Methods Division

FAA Partnership to Enhance General Aviation Safety, Accessibility, and Sustainability

PRATT & WHITNEY DEPENDABLE ENGINES

Supported by Propulsion & Energy and Defense & Space Divisions

Pratt & Whitney Center of Excellence in Aeropropulsion

AIRBUS

Center of Excellence for MBSE Enabled Overall Aircraft Design

Supported by Advanced Configurations, Advanced Methods, and Digital Engineering Divisions

SIEMENS

Center of Excellence for Simulation and Digital Twin

Supported by Digital Engineering Division

BOEING

Boeing Strategic Partnership for 21st Century Aerospace Manufacturing

Supported by Digital Engineering and Advanced Configurations Divisions

Strategic University Partners

Sandia National Laboratories

Supported by Defense & Space and Civil Aviation Research Divisions

LOCKHEED MARTIN

Supported by Defense & Space and Digital Engineering Divisions

Georgia Tech Aerospace Systems Design Laboratory

Modes of Engagement with Industry

- Sponsored Research
- Centers of Excellence, Strategic Alliances, Fellowships
- **Grand Challenges**
- Professional Master's in Applied Systems Engineering

Georgia Tech Aerospace Systems Design Laboratory

ASDL Grand Challenges

- Open-ended, relevant, realistic research problems
- Part of the ASDL core academic and research methods training
- Exercised over two entire academic semesters (Fall & Spring)
- Requires a very deep understanding of the problem, underlying theory and assumptions
- Requires practical implementation of advanced methods beyond traditional senior design problems
- Represent a significant contribution to the field

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General Guidelines for Grand Challenges

- Emphasize story telling—every story must have a beginning, middle and end
- Make the story interesting and clear
- Formulate the problem clearly:
  - What is the problem to be addressed?
  - What motivates interest?
  - Why is it hard? Why is it important?
  - How is it done today, by whom, and what is wrong with it?
- How do you propose to address it?
- What's the new idea here, and why can we succeed now but not before?
- What recent breakthroughs now make this possible?
- What is your plan and technical approach?
- What are the biggest challenges and why?
- Formulate the Grand Challenge as a decision support problem
- Create an interactive parametric M&S environment to support decision making

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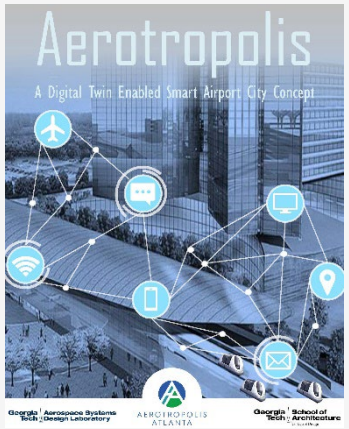
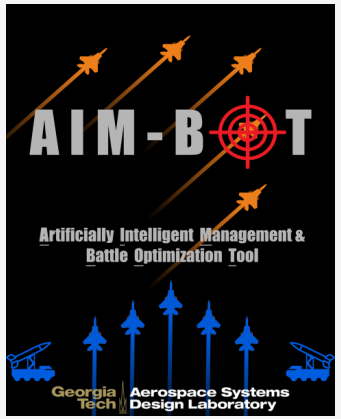
2020-2021 System of Systems Grand Challenges



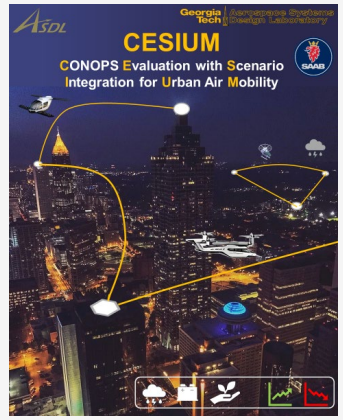
Aerotropolis: A Digital Twin Enabled Smart Airport City Concept

AFFECT: Aircraft Future Fleet Emissions and Composition Tool

AFLOAT: Amphibious Fleet Layout Optimization and Acquisition Tool

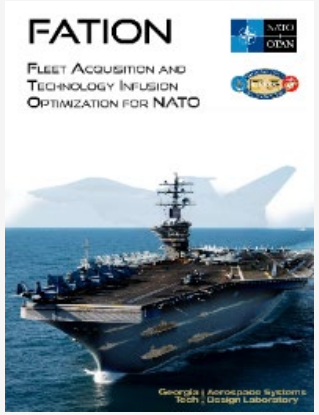


AIM-BOT: Artificially Intelligent Management & Battle Optimization Tool

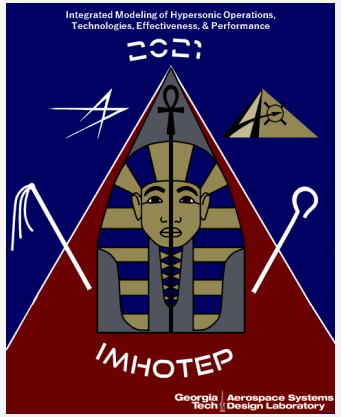


CESIUM: CONOPS Evaluations with Scenario Integration for Urban Air Mobility

DELITE: Digital-Twin EnabLed VIrtual Testing Environment



FATION: Fleet Acquisition and Technology Infusion Optimization for NATO



IMHOTEP: Integrated Modeling Hypersonic Operational Technology Evaluated Policy

JEDI: Joint Environment for Design and Innovation

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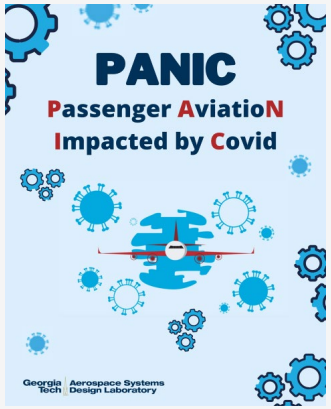
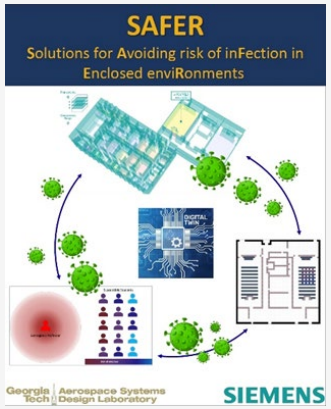
2020-2021 System of Systems Grand Challenges



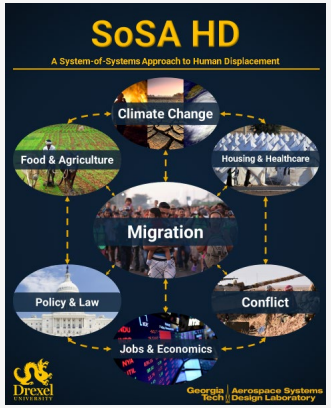
PANIC: Passenger AviatioN Impacted by Covid

Polar BEAR: Polar Battlespace Environment and Advanced Reconnaissance

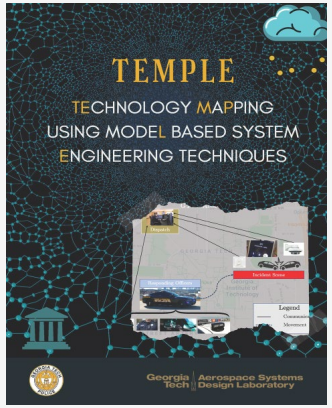


SAFER: Solutions for Avoiding Risk of InFection in Enclosed EnviRonments

SNARL: Selecting Novel Assets using Reinforcement Learning

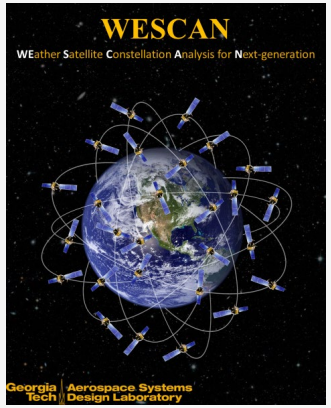


SoSA HD: A System-of-Systems Approach to Human Displacement



TEMPLE: TEchnology MaPping using ModeL Based System Engineering Techniques

TIPS: Turbulence Incident Prediction for Safety Analysis



WESCAN: WEather Satellite Constellation Analysis for Next-generation

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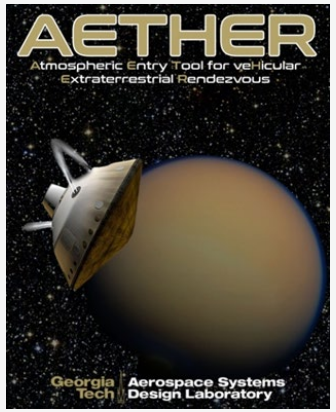
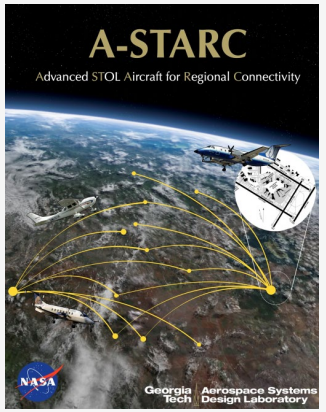
2020-2021 Vehicle Design Grand Challenges



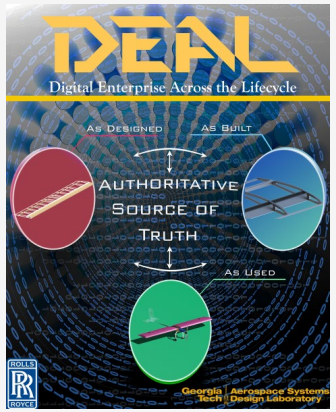
AETHER: Atmospheric Entry Tool for VeHicular Extraterrestrial Rendezvous



A-STARC: Advanced STOL Aircraft for Regional Connectivity

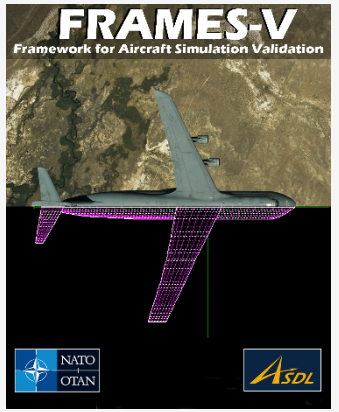
CETRA: CErtification of TRansport Aircraft

CHASE: Commercial Hydrogen Aircraft Sizing Environment



DEAL: Digital Enterprise Across Lifecycle

DEPARTT: Development of Electric Propulsion Architectures for Remote Tactical Transport



FRAMES-V: Framework for Aircraft Simulation and Validation

HYPERsense: Refurbishable Hypersonic Reconnaissance Vehicle

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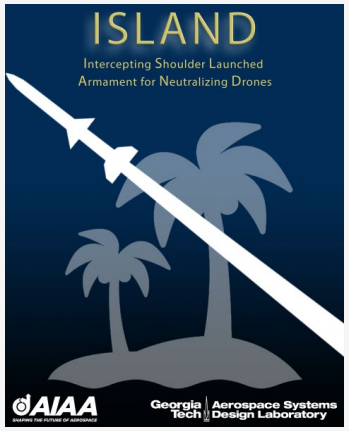
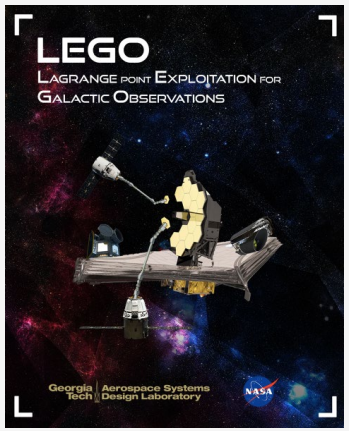
2020-2021 Vehicle Design Grand Challenges

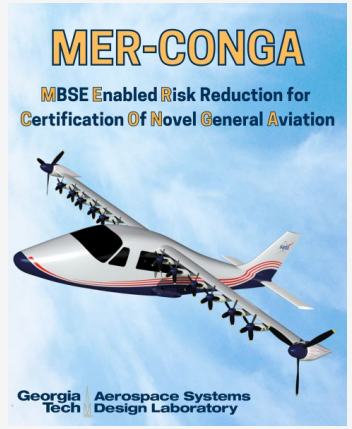


ISLAND: Intercepting Shoulder-Launched Armament for Neutralizing Drones

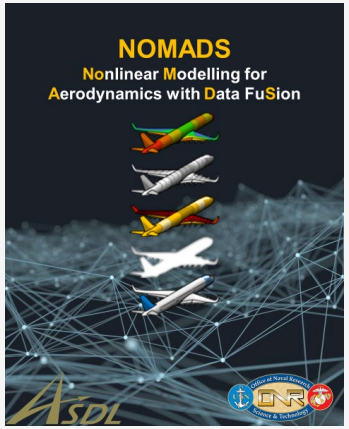


LEGO: Lagrange Point Exploitation for Galactic Observations

MARVIN: Model-Based AppRoach for an In-Space Vehicle DesIgn ENvironment

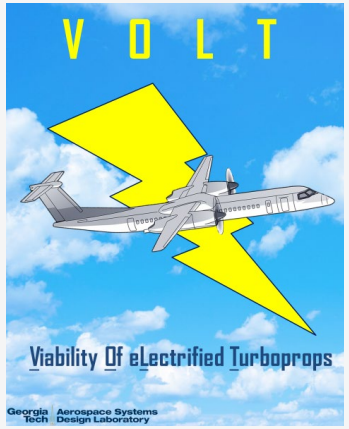


MER-CONGA: MBSE Enabled Risk Reduction for Certification of Novel General Aviation

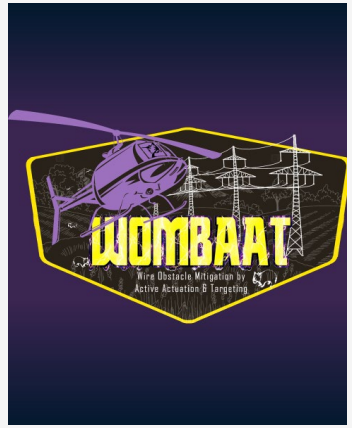


NOMADS: NOnlinear Modeling for Aerodynamics with Data FuSion

QSTTOL: Quiet Supersonic Transport for Take-Off & Landing



VOLT: Viability of ELectrified Turboprop



WOMBAAT: Wire Obstacle Mitigation by Active Actuation and Targeting

Georgia Tech Aerospace Systems Design Laboratory

Modes of Engagement with Industry

- Sponsored Research
- Centers of Excellence, Strategic Alliances, Fellowships
- Grand Challenges
- **Professional Master's in Applied Systems Engineering (PMASE)**

Georgia Tech Aerospace Systems Design Laboratory

PMASE – Program Overview

- Program focuses on the development of “systems thinking”
- Curriculum highlights the integrative nature of SE
- Courses and labs provide knowledge and tools that will benefit your day-to-day job
- Capstone project allows you to apply what you have learned to a real-world problem
- Program provides a foundation for SE Professional certification through International Council on Systems Engineering
- PMASE is a formal Georgia Tech degree, not just a certificate program

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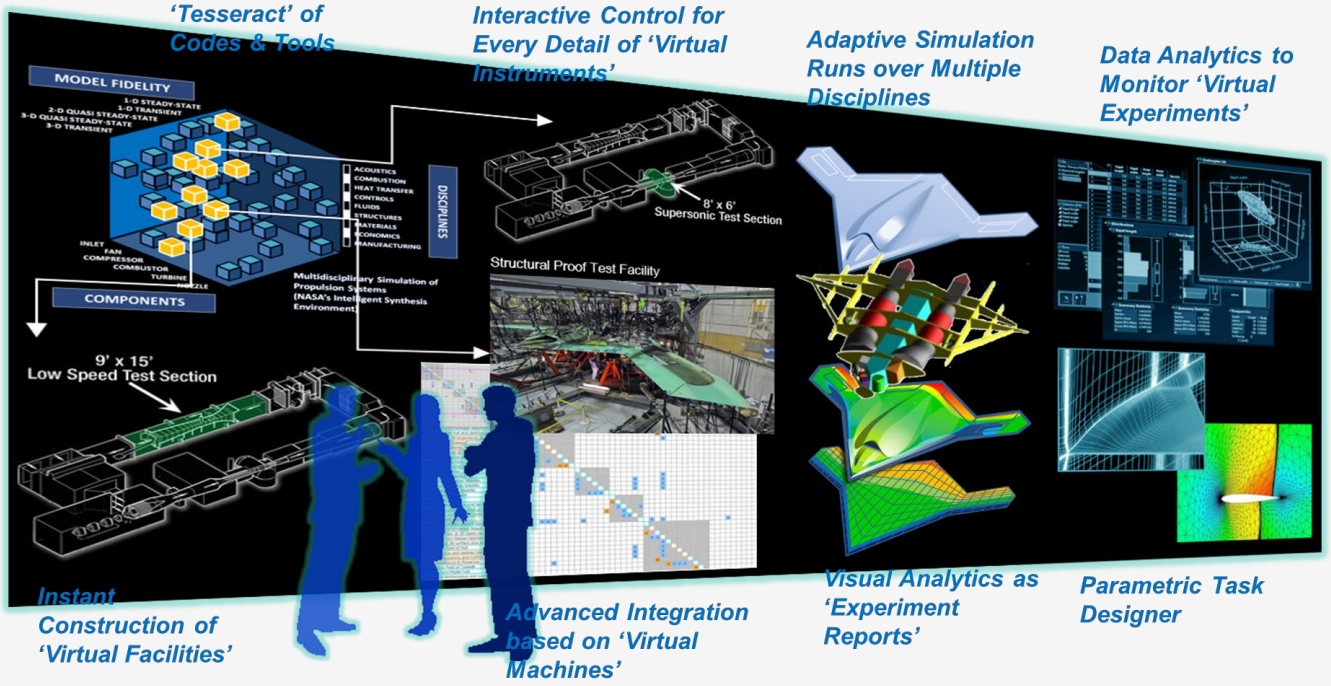
The Future of Engineering Simulation



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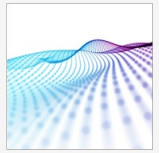
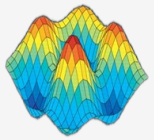
The Future of Engineering Simulation – Key Components



Sensor/Data Fusion

Beyond interpolation of single data source, multiple source-driven synthesis for consistent and robust interpretation and prediction

- Aerodynamic Pressure Fusion
- Process Analysis for Smart Manufacturing
- Dynamic Inference for Building Energy Demand



Physics-Informed Deep Learning

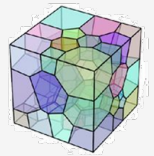
By leveraging automatic differentiation and minimizing residual error, first-order physics can enhance Deep Learning in data-scarce engineering domain

- Solving PDEs without computational grid
- Associating missing data with physics

Meta Machine Learning

Automated model selection, tuning, and training for any given dataset

- Hyper-parameter tuning by Bayesian Optimization
- Computational cost reduction by distributed queuing and training



Geometric Deep Learning

GDL can greatly extend the current capability of Deep Learning for unstructured data forms

- Inference for CFD Mesh Data
- Sensor Fusion from a Graph

Data-Driven Decision Making

Application of deep reinforcement learning for challenging real-world problems

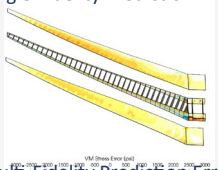
- Contextual, Real-Time Command Recommendation for Complex Engineering Software
- Non-Parametric Aerodynamic Shape Optimization
- Teaching Machine by Human Demonstration

Explainable AI/ML

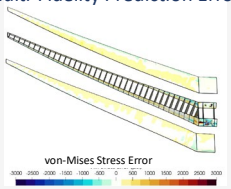
By remapping complex functions into low-dimensional space, enhance readability of inference by AI/ML models

- Hybridization between ML and Symbolic Regression
- AI/ML applications in safety-critical applications

Single-Fidelity Prediction Error:



Multi-Fidelity Prediction Error:



Multi-fidelity ROM

Cloud Computing

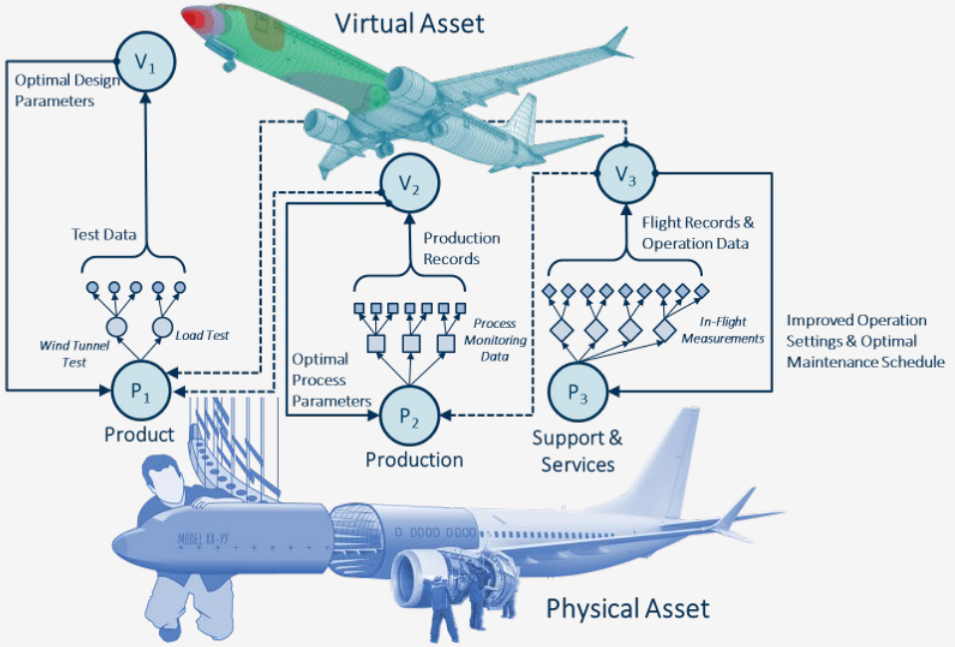
Internet of Things

Digital Twin: A virtual representation of a connected physical asset

Virtual Representation

Transfer of data/information

Physical Realization



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[1] https://www.mimeo.com/wp-content/uploads/2020/09/welcome-to-industry-4-0-supporting-the-internet-of-things-with-print.jpg
[2] https://imageio.forbes.com/specials-images/imageserve/5f9fa9e815da35da1356a28b/The-5-Biggest-Cloud-Computing-Trends-In-2021/960x0.jpg?fit=bounds&format=jpg&width=960

Georgia Tech Aerospace Systems Design Laboratory

Digital Engineering: Multiple Avenues for Collaboration

Centers of Excellence

Siemens Invests in Georgia Tech, Launches Center of Excellence for Simulation and Digital Twin

OCTOBER 11, 2021

Preparing the STEM Workforce: from left **Olivia Pinon Fischer**, **Denise Quarles**, **Larry Jacobs**, **Dimitri Mavris**, **Virginie Maillard**, **Barry Powell**, **Dave Rapaport**, **Olivia Kolovich**, and **John Petrillo.**

On 4 October, Siemens Technology and Georgia Institute of Technology officially launched the Center of Excellence for Simulation and Digital Twin. With research at the forefront, engineers, scientists and researchers will work with undergraduate and graduate students to utilize data- and model-driven capabilities to optimize complex infrastructure systems.

The $1.8 million investment from Siemens in Georgia Tech's Aerospace Systems Design Laboratory (ASDL) will prepare students to enter the STEM workforce of the future while improving upon the role of digital engineering for buildings. The initiative will include sponsored research, U.S.-government funded activities, two annual student Grand Challenge projects and four PhD fellowships centered around the use of simulation capabilities. The Center of Excellence will be led by Regents Professor **Dimitri Mavris**, director of ASDL, and by a managing board made up of several Siemens leaders representative of the company's Research, Smart Infrastructure, and Digital Industries Software units.

Dimitri Mavris

"Building upon our decades-long relationship with Georgia Tech, our investment is a step towards having a greater understanding of the challenges we face today and prepare to face tomorrow utilizing digital twins," said **Virginie Maillard**, Head of Siemens Technology US. "We pride ourselves on our involvement with higher education institutions and our master research agreement with Georgia Tech underscores our joint commitment to innovation while simultaneously preparing the workforce of tomorrow."

"We are excited to be part of the new Center of Excellence that Siemens is establishing at Georgia Tech," said Mavris. "Digital engineering is a key thrust for ASDL and this center will allow us to further our research in this area. In partnership with Siemens, we will focus on topics that will engage our students to advance the development and application of simulation and digital twins."

The 4 October launch event was part of a larger kickoff meeting hosted by ASDL on campus that included students interacting with Siemens leaders to discuss the Grand Challenge projects. The two Grand Challenges for academic year 2021-2022 focus on the use of digital twins to explore, optimize and plan infrastructure for buildings, communities and mobility solutions. Using Hartsfield-Jackson Atlanta International Airport as a "living lab," students will investigate the interactions between the airport structure and the surrounding city to make best use of efficient technologies.

Virginie Maillard meeting with ASDL students during the kickoff event

The four PhD fellowship topics of focus include how to better understand and build upon direct human-machine collaboration through AI, investigating a dynamic system-of-systems architecture that scales itself as environments change, exploring technologies for engineering resiliency, self-healing systems, and discovering methodologies for digital twin validation and calibration.

Georgia Tech is one of the lead universities in Siemens' newly developed regional Research & Innovation Ecosystem program. Atlanta will be one of the four ecosystems, alongside the Bay Area, Greater Boston and the Industrial Midwest to increase engagement between Siemens Technology and universities and research institutes in a more focused manner.

With over 2,000 employees, including more than 160 veterans, Atlanta is a pivotal hub for Siemens USA. The company is helping the Atlanta region innovate its infrastructure, which serves as home base to more than a dozen Siemens facilities, including a manufacturing facility and a MindSphere Application

https://ae.gatech.edu/news/2021/10/siemens-invests-georgia-tech-launches-center-excellence-simulation-and-digital-twin

Sponsored Research

Boeing-Georgia Tech Collaboration Still Strong After 10+ Years

NOVEMBER 29, 2018

For more than 10 years, the Georgia Tech and Boeing Strategic Technical Universities (STU's) have been training the next generation of technical leaders through a collaboration that develops transformative design and manufacturing technologies as a part of its curriculum. At their annual program review, Nov. 8 and 9, leaders from Tech and Boeing agreed that there's still plenty to do.

Shreyes Melkote and Larry Schneider

"Ultimately, this relationship brings together our need to conduct cutting edge research and our need to develop highly skilled engineers for the future," said **Larry Schneider,** a 1985 graduate of Georgia Tech's Daniel Guggenheim School of Aerospace Engineering and Boeing's vice president for Commercial Airplanes.

"In that regard, we are very happy to work with the AE School, because the students are so advanced," he said.

Boeing leaders gathered at Georgia Tech's Fuller E. Callaway, Jr. Manufacturing Institute (GTMI) to review the progress made by the teams of Georgia Tech student researchers who have been working with Boeing engineers on more than a dozen projects over the past year. Overseeing the two-day meeting were GTMI associate director, **Shreyes N. Melkote** and Boeing associate Technical Fellow **Howard Appelman**. Joining them were faculty from Georgia Tech's College of Computing, the Institute for Robotics and Intelligent Machines (IRIM), and the schools of Aerospace, Mechanical, Material Science, and Industrial Systems engineering.

The projects range in complexity and goals, but are generally focused on developing next generation manufacturing technologies including design, automation, materials and systems integration.

Olivia Pinon Fischer, a research faculty in the Daniel Guggenheim School, said her team's project, "*Future Factory Manufacturing and Supporting Applications for Equipment and Process Health Monitoring*" has been working on the development of digital twins -- virtual representations of physical assets that integrate data-driven and physics-based models to help assess machine health and optimize operations throughout the factory.

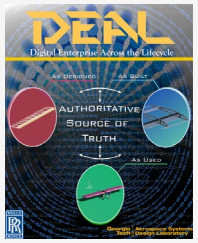
"While our approach this year was implemented on a machine here at Georgia Tech, we hope to be able to transition this capability to Boeing machines in the near future," she said.

"Meanwhile, our students are getting the experience of working on a problem that is very relevant to this industry right now. And they are getting the experience of explaining their work not only to subject matter experts, but to executives as well."

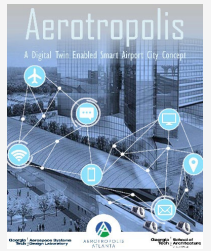
Spread out across the 11 years in which the SUP program has been in existence, the scenario that Fischer describes has had a major impact on the educational experience of many Georgia Tech students. All told, the SUP program estimates it has involved 75 doctoral students, 40 master's students, 46 undergrads, six post-docs, and four research engineers. It has generated more than 180 papers and presentations, 14 faculty and student awards, and 10 invention disclosures.

https://ae.gatech.edu/news/2018/11/boeing-georgia-tech-collaboration-still-strong-after-10-years

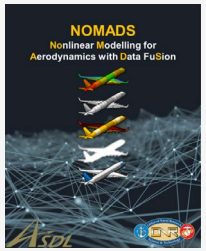
Grand Challenges



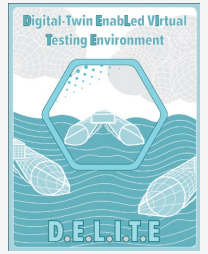
DEAL: Digital Enterprise Across Lifecycle



Aerotropolis: A Digital Twin Enabled Smart Airport City Concept



NOMADS: NOnlinear Modeling for Aerodynamics with Data FuSion



DELITE: Digital-Twin EnabLed VIrtual Testing Environment

SAFER: Solutions for Avoiding Risk of InFection in Enclosed EnviRonments

Involvement in Professional Societies & Working Groups

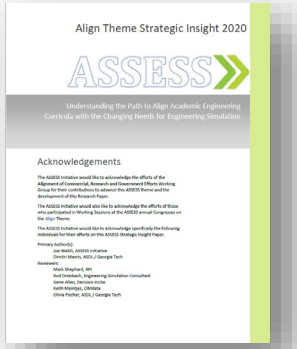
NAFEMS

AIAA
SHAPING THE FUTURE OF AEROSPACE

digital twin™
CONSORTIUM

ASSESS

DIGITAL TWIN SUMMIT
POWERED BY ASME



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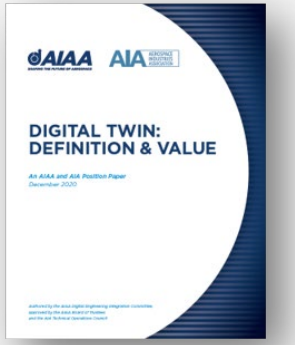

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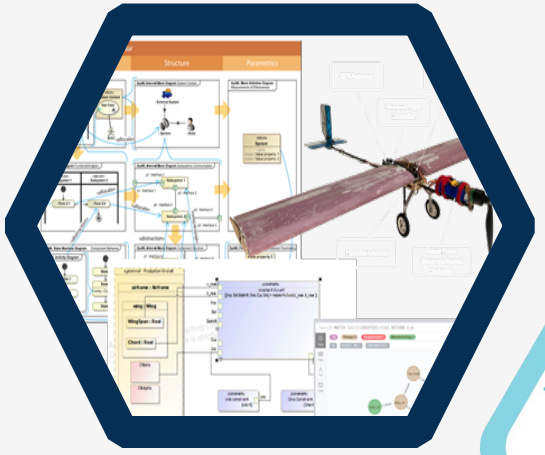
Georgia Tech Aerospace Systems Design Laboratory

Towards Digital Twin Realizations

For complex engineering systems

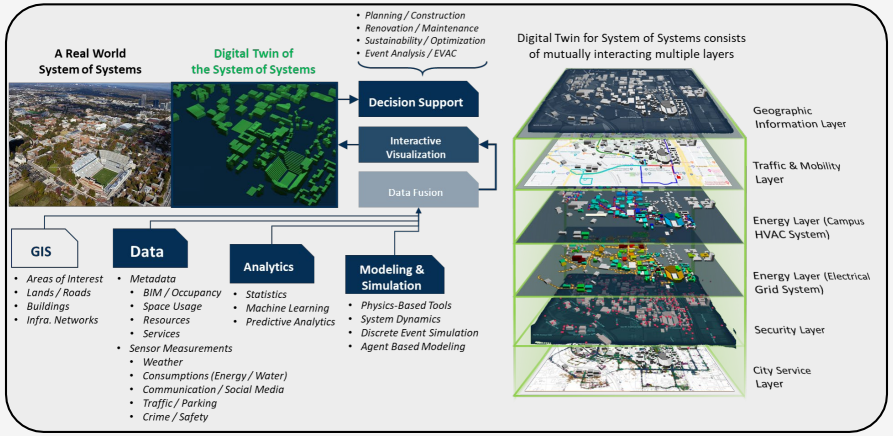


Digital Enterprise Across the Lifecycle

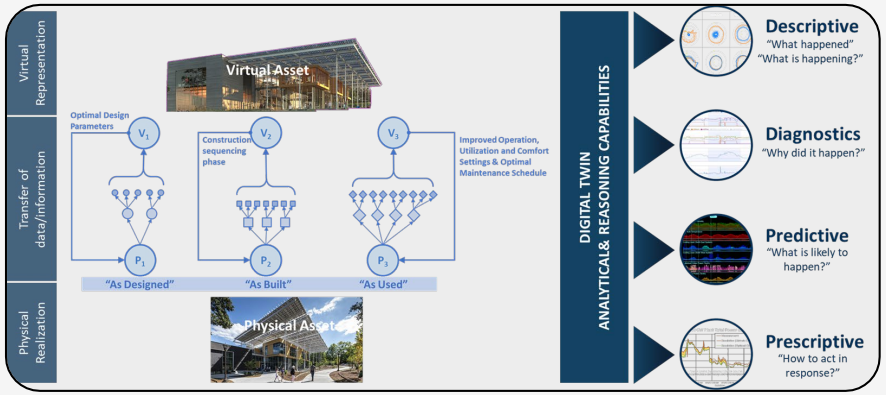
Digital Twin-enabled Virtual Testing Environment

For socio cyber-physical systems

Digital Twin of the Georgia Tech Campus

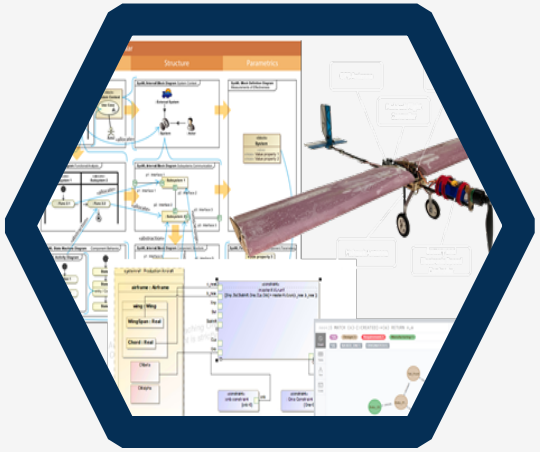


Digital Twin of Campus Building



Georgia Tech Aerospace Systems Design Laboratory

Towards Digital Twin Realizations



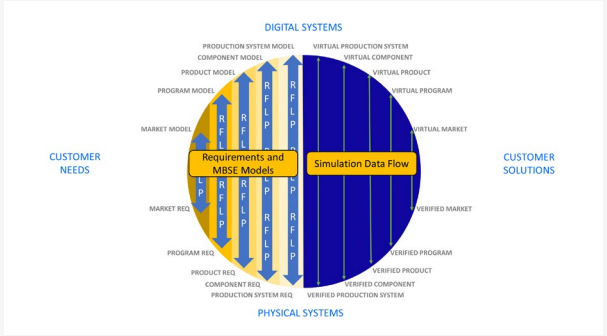
Digital Enterprise Across the Lifecycle

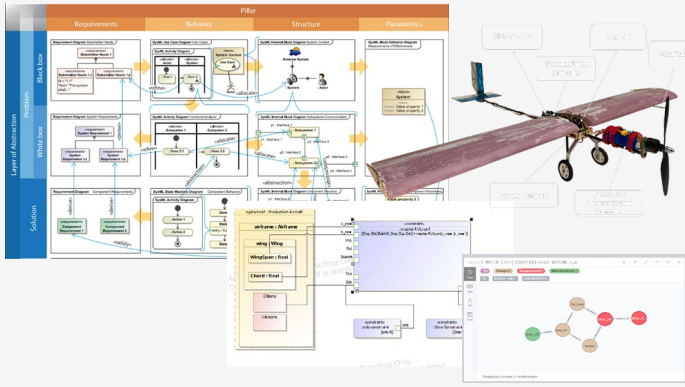
Motivation

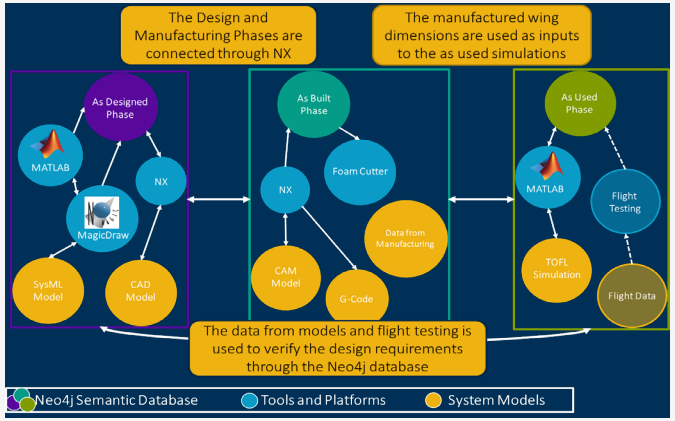
- Increase in products' complexity and level of integration lead to significant challenges in all phases of the product lifecycle
- Coupling between disciplines presents compatibility and collaboration challenges that must be addressed throughout the development of a product

Goal: Address current limitations of PLM with the concept of digital enterprise

Objective: Formulate, develop and implement a digital enterprise across the lifecycle of a system of interest



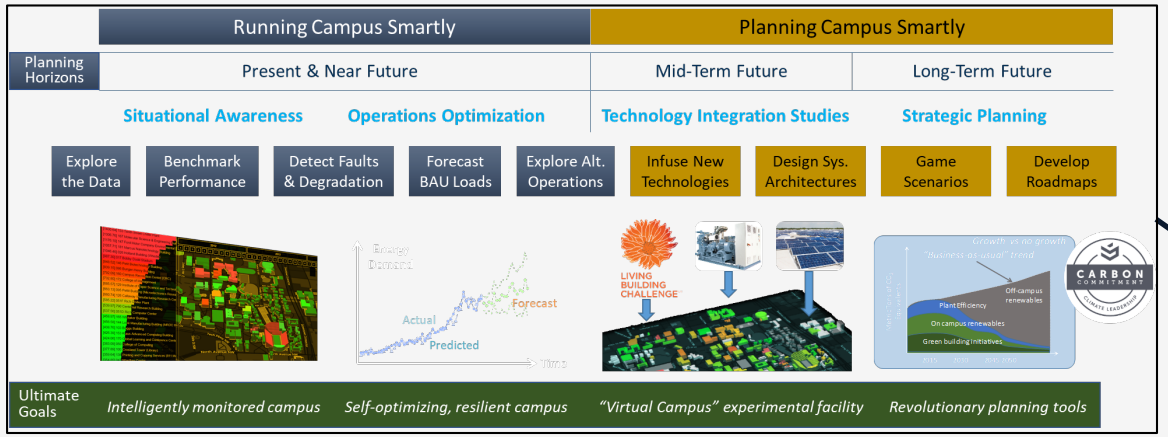


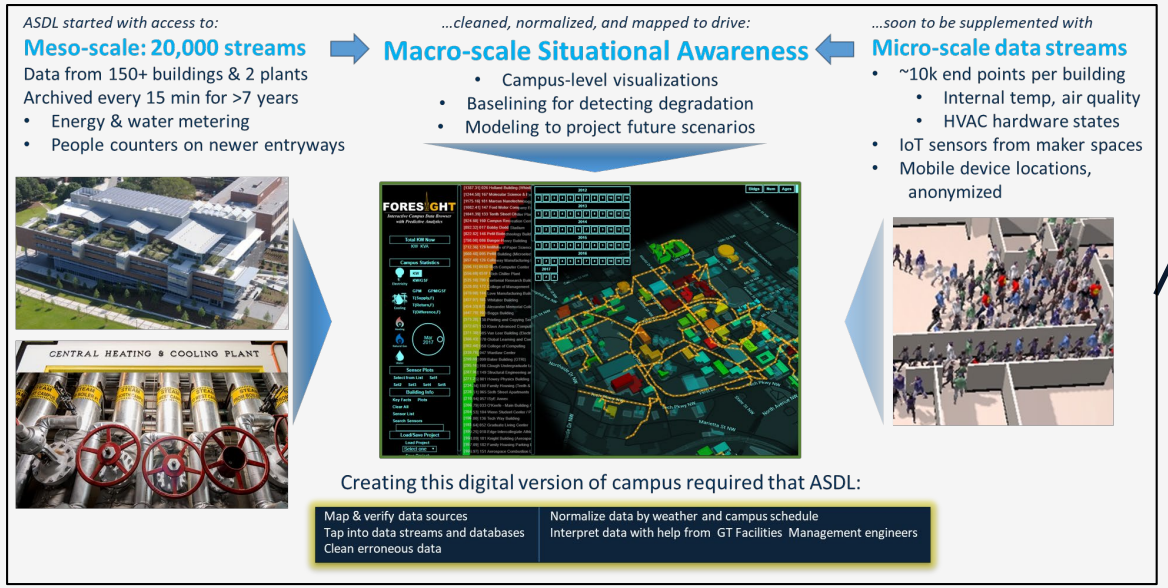


O. Kargin, A. Barnes, D. Onur, O.J. Pinon-Fischer, M.G. Balchanos, D.N Mavris, M. Hughes, J. LaJeunesse, A. Karl and J. Matlik, "Digital Enterprise Across the Lifecycle", 2021 AIAA SciTech Aerospace Sciences Meeting, January 2021

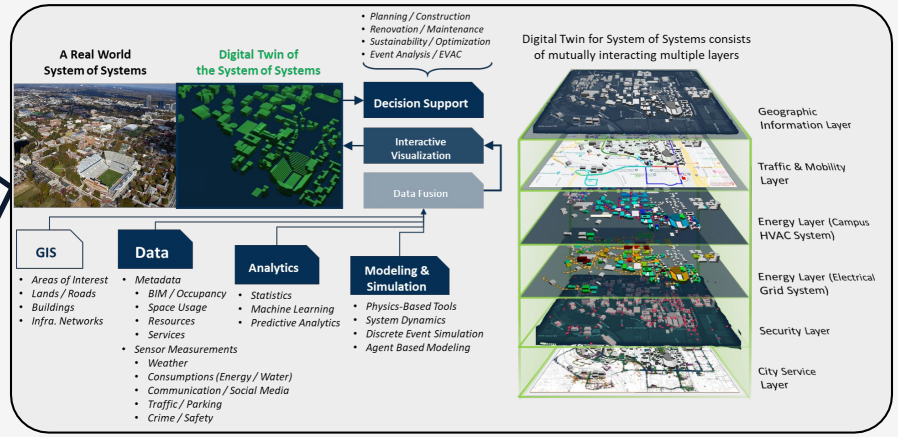
Georgia Tech Aerospace Systems Design Laboratory

Towards Digital Twin Realizations





Digital Twin of the Georgia Tech Campus

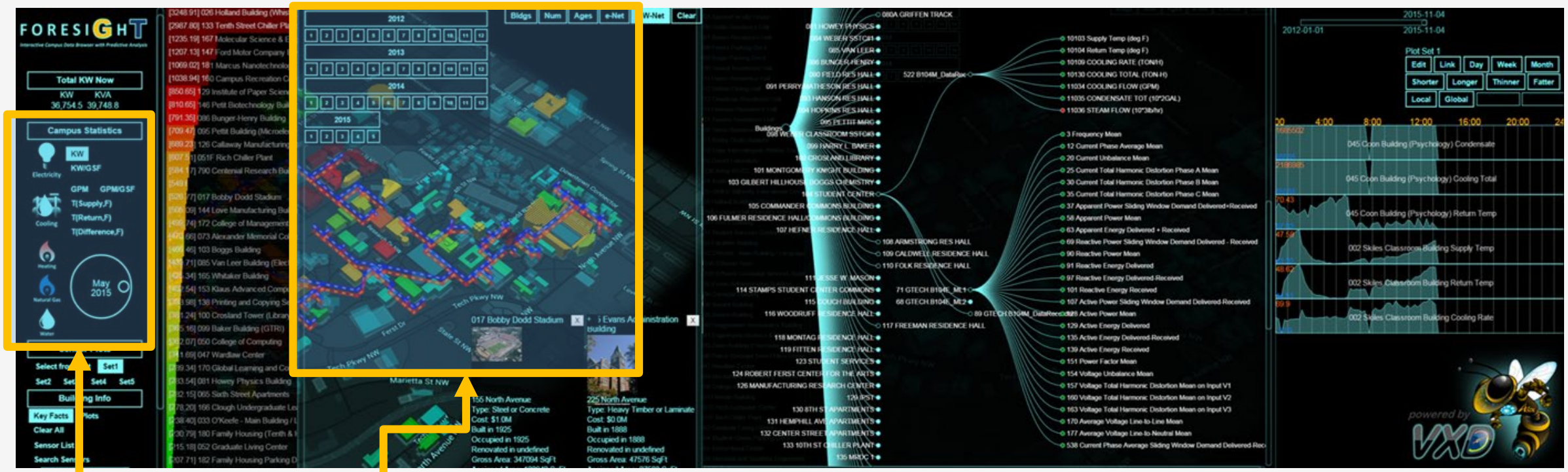


- D. N. Mavris, M. Balchanos, WJ Sung, and O. J. Pinon, A Data Mining and Visual Analytics Perspective on Sustainability-Oriented Infrastructure Planning, Lecture Notes in Computer Science, Vol. 9714, pp.330-341, Ying Tan and Yuhui Shi (Eds), Springer, doi: 10.1007/978-3-319-40973-3_33, 2016
- D. N. Mavris, M. G., Balchanos, WJ. Sung and O. J. Pinon, Towards a big Data-Enabled Virtual Experimentation Framework for Sustainability-Oriented Large-Scale Infrastructure Planning, International Conference on Adaptive Modeling and Simulation (ADMOS 2017), Verbania, Italy, 26-28 June, 2017

Georgia Tech Aerospace Systems Design Laboratory

Towards Digital Twin Realizations

Interactive, visual-analytics based campus data browser, supporting real-time situational awareness, campus-level energy usage monitoring and model-based energy usage predictions, based on real time data streams

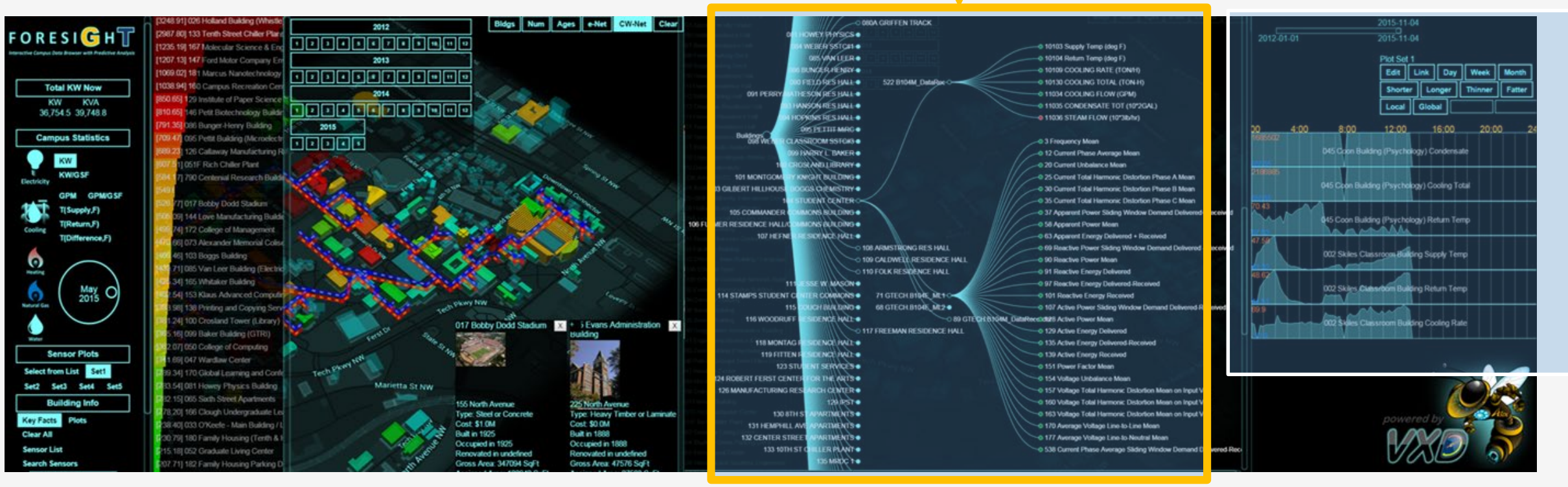


User can navigate through time/campus location and observe past energy performance trends for any building of interest

Georgia Tech Aerospace Systems Design Laboratory

Towards Digital Twin Realizations

Real-time measurements and historic data queried from repositories maintained by campus facilities, and is sourced from sensor measurements and meter readings installed across campus buildings



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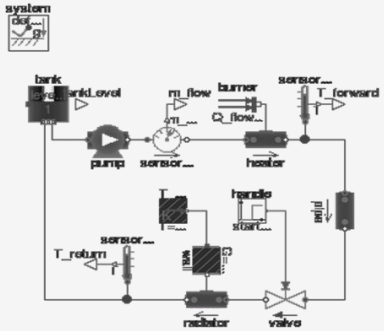

Physics-based Modeling & Simulation

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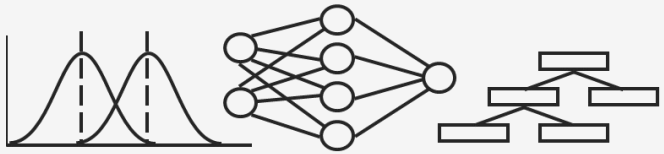
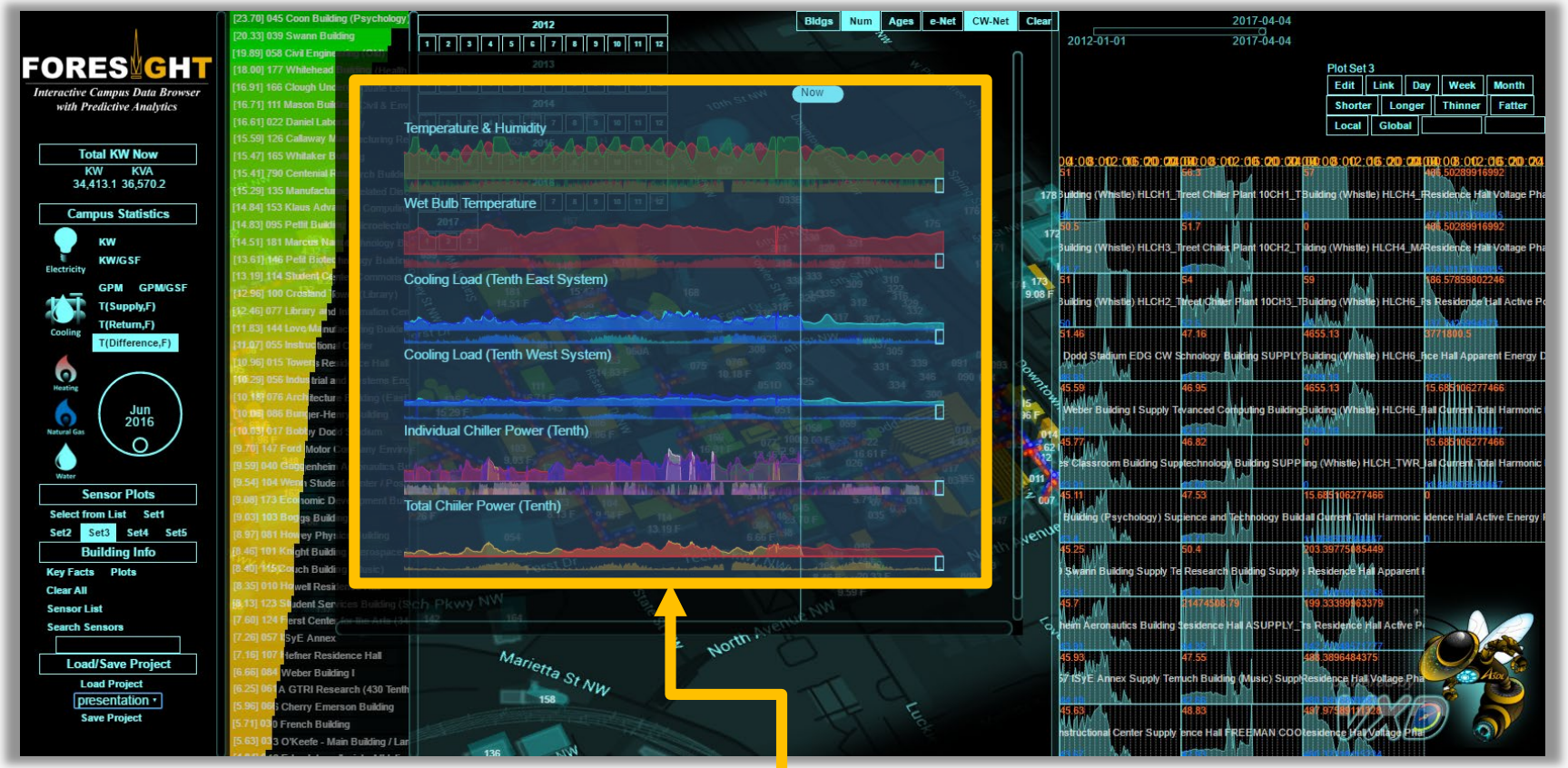


Data-Driven Models



Comprehensive prediction capability for campus-wide energy usage that includes varying energy demand, accounts for total campus cooling load fluctuations, and utilizes weather forecast data

Georgia Tech Aerospace Systems Design Laboratory

Closing Remarks

- Academia & Industry Collaboration is critical to
  - Bridge the knowledge and capability gaps
  - Foster lifelong learning, teach our students to be resilient, flexible and responsible, and help them develop their leadership skills while giving them the opportunity to be creative
  - Reduce the time it takes to transition a newly-hired engineer into a productive actor of any engineering team and processes.

Georgia Tech Aerospace Systems Design Laboratory

ACADEMIA & INDUSTRY COLLABORATION:

PREPARING STUDENTS FOR CAREERS IN ENGINEERING SIMULATION

HOSTED BY NAFEMS AMERICAS

Q&A

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