



# Systems

The Systems Department at UTRC develops innovative technology solutions and concepts in the area of complex adaptive systems to provide growth and competitive advantage to UTC's businesses. We focus on solving problems related to designing, controlling and managing systems that are characterized by complex interactions between a large number of independent and heterogeneous components (and sub systems).

The Department's core strengths and expertise are articulated along the following disciplines:

- Systems Dynamics & Optimization
- Controls Systems
- Power Electronics Systems
- Embedded Systems & Networks
- Decision Support & Machine Intelligence

## Systems Dynamics & Optimization

- **Technologies:** Dynamical systems; uncertainty quantification; multi-scale complex system modeling; mathematics on graphs; computational mathematics.
- **Applications:** Fuel cell modeling; stiff differential algebraic equation; dynamical systems analysis; propagation of uncertainty in large networks.

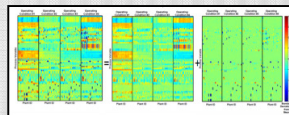
## Embedded Systems & Networks

- **Technologies:** Scalable hardware and software architectures-intelligent middleware; wireless; energy harvesting; formal methods; verification and validation; code synthesis.
- **Applications:** Safety- and security-critical distributed embedded systems; efficient, real-time computation in distributed embedded systems.

## Decision Support & Machine Intelligence

### Technologies:

- Machine learning
- Sensor fusion
- Diagnostics & prognostics
- Compressive sensing
- Video analytics
- Data mining
- Data driven modeling



### Applications Include:

- System health monitoring
- Security & surveillance
- Building energy management
- Fleet maintenance
- Decision making under uncertainty
- Remaining useful life of mechanical systems.



## Power Electronics Systems

- **Technologies:** High density converters; high temperature devices; high frequency devices; converter topologies.
- **Applications:** Power systems analysis; distributed energy resources; micro grid and smart grid; energy storage.

## Controls Systems

### Technologies:

- Control-oriented dynamic modeling; control and estimation architecture algorithm analysis; design for stability; robustness and optimality; Rapid prototyping; hardware-in-the-loop. Validation and verification of controllers.

### Applications:

- Model predictive control for HVAC systems; Power management for durable fuel cell power plants. ;Mission adaptive control of helicopters.

United Technologies Research Center (UTRC) is the central research organization of United Technologies (NYSE:UTX).

Please visit us at [www.utrc.utc.com](http://www.utrc.utc.com) for more information.

# Defining the Future

Hamilton Sundstrand

Sikorsky



Otis



**United Technologies  
Research Center**

Pratt & Whitney



Carrier



UTC Power



UTC Fire & Security



**United  
Technologies**

**United Technologies Corporation (NYSE: UTX)** is a diversified company whose products include Carrier heating and air conditioning, Hamilton Sundstrand aerospace systems and industrial products, Otis elevators and escalators, Pratt & Whitney aircraft engines, Sikorsky helicopters, UTC Fire & Security systems and UTC Power fuel cells.

**United Technologies Research Center** develops the world's most advanced technologies and processes to help ensure the products delivered to market by the UTC businesses are the best available.

The challenges undertaken at UTRC require the best minds working together to generate ideas, test theories, challenge assumptions and ultimately deliver solutions. UTRC has approximately 500 employees and more than 96% of our technical staff hold advanced degrees.

Founded in 1929, United Technologies Research Center (UTRC) is located in East Hartford, Connecticut (U.S.), and also operates research and development centers in Berkeley, California, Shanghai, China, and Cork, Ireland.