Guidance, Navigation, Control (GNC) strategies and algorithms for single UAV and a fleet of UAVs; 5) Cooperative localization, deployment, and control strategies of a fleet of UAVs with remote sensing sensors for optimal coverage; 6) Autonomous path planning and re-planning strategies; 7) Ground station development for safe and efficient operation of the UAVs system.

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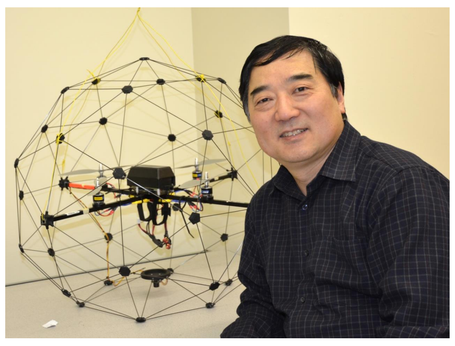
9th SAFEPROCESS PARIS Sept 2-4, 2015
IFAC International Symposium on Fault Detection, Supervision and Safety for Technical Processes

ARTS ET MÉTIERS ParisTech

informatiques mathématiques Inria

# Development of Advanced FDD and FTC Techniques with Applications to Unmanned Systems, Smart Grids and Manufacturing Processes

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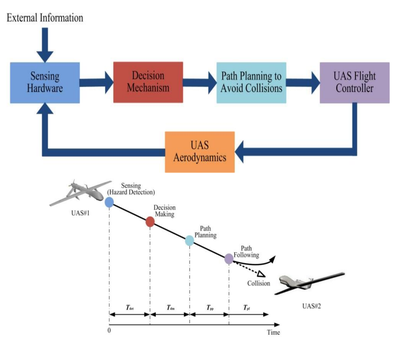
## Research Areas

- Guidance, Navigation, Control (GNC), Sense & Avoid (S&A) of manned and unmanned vehicles (aerial, space, ground, surface and underwater)
- Monitoring, Fault Detection and Diagnosis (FDD), prognosis and health management, Fault-Tolerant Guidance, Navigation, and Control (FT-GNC)
- Cooperative control of multiple vehicles/systems for various application missions under normal and fault conditions
- Systems modelling, estimation, identification, and simulation techniques under normal and fault conditions

## Unmanned vehicles and remote sensing techniques applied to forest fires, pipelines, power lines, environment, natural resources and disasters monitoring, detection, and protection

- Development of remote sensing techniques with applications
- Development of GNC techniques using single/multiple vehicles
- Development of imagine processing techniques with applications

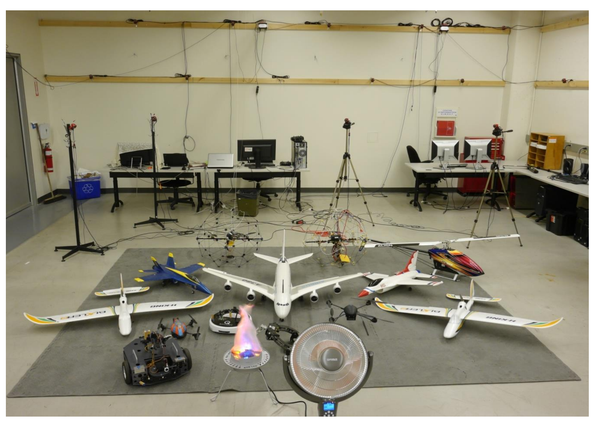
## Sense and Avoid (S&A) of Unmanned Aerial Vehicles (UAVs)

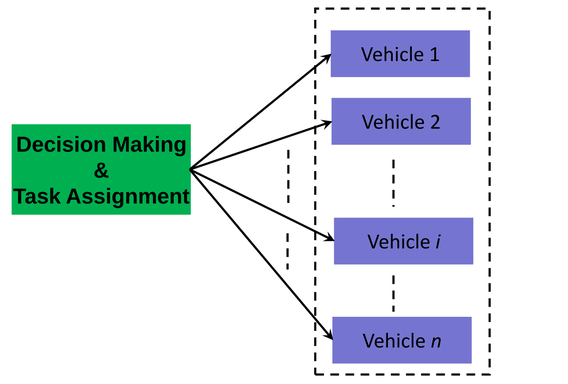



**The developed technologies for S&A**

- Collision detection
- Path Planner for a single intruder
  - Differential Geometric Guidance
- Path Planner for multiple intruders
  - Markov Decision Process
- Make the path feasible for UAVs
  - Differential Flatness Approach

## Cooperative and Fault-Tolerant Cooperative Control (FTCC) of multiple Unmanned Vehicles (UVs)

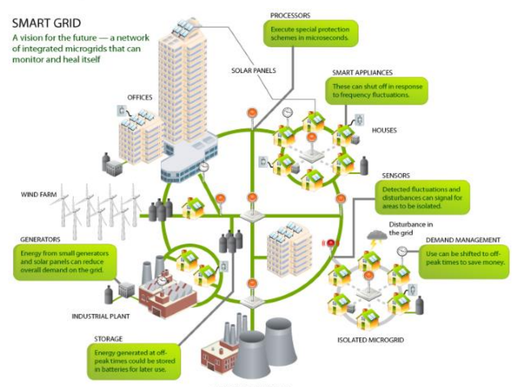





***N* vehicles in cooperative control**

- GNC strategies and algorithms for single vehicle and a fleet of UVs
- Cooperative localization, deployment, and control strategies of a fleet of UVs
- Autonomous path planning and re-planning strategies of UVs under different missions
- Ground station development for safe and efficient operation of the UV systems

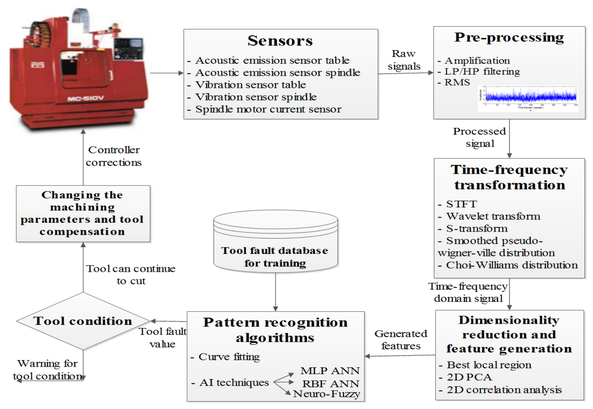
## Condition monitoring, diagnosis, and self-healing control and management of wind turbines, renewable energy systems, and smart grids/microgrids




**Real-time Monitoring, Diagnosis,** and **Fault-Tolerant Control**
↓
**Condition-Based Maintenance**
↓
Higher **reliability** and **availability**
↓
Lower **O&M** costs

| Existing Grids | Smart Grids |
|---|---|
| Electromechanical | Digital |
| One-Way Communication | Two-Way Communication |
| Centralized Generation | Distributed Generation |
| Hierarchical | Network |
| Few Sensors | Sensors Throughout |
| Blind | Self-Monitoring |
| Manual Restoration | Self-Healing |
| Failures and Blackouts | Adaptive and Islanding |
| Manual Check/Test | Remote Check/Test |
| Limited Control | Pervasive Control |
| Few Customer Choices | Many Customer Choices |

## Machining tools and machining processes condition monitoring, diagnosis, and prognosis




- Tool faults may deteriorate product quality and surface finish and cause dimensional inaccuracy
- Machines and work pieces may be damaged/destroyed (unscheduled downtime) due to tool breakage
- Cutting tools should be maximally utilized to reduce tooling costs
- It is in high demand for manufacturing industries to continuously monitor the tool wear conditions

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