PHM TEAM

Prognostics and Health Management

Head J.-M. Nicod (Prof ENSMM)

Industrial and societal challenges

- Assessment of the health state
- Estimation of remaining useful life of systems
- Decision to manage or design systems

➡ **sustainability**

Staff

8 permanent staff, ~10 students, eng. and postdocs

- 2 full professors (Jean-Marc Nicod and Noureddine Zerhouni)
- 5 associate professors (Rafael Gouriveau, Kamal Medjaher, Brigitte Morello, Emmanuel Ramasso, Christophe Varnier)
- 1 engineer (Patrick Nectoux)

Partnerships

Academic

out of France

- University of Cranfield (UK)
- University of Crete (Greece)
- EPFL, Lausanne (Switzerland)
- Simtech Institute (Singapore)
- SGT Inc., NASA Ames Research Center (USA)
- University of Texas (USA)

in France

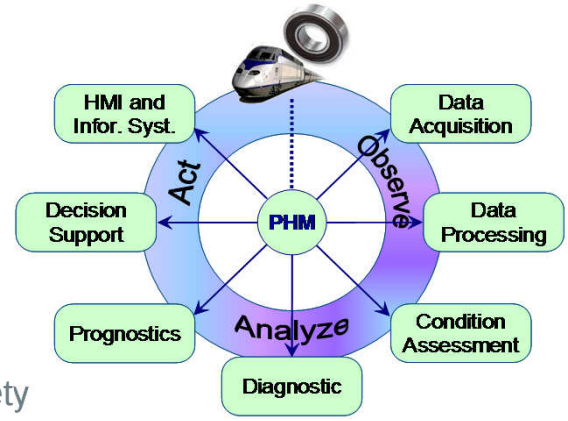
- FCLAB (Belfort)
- FESB
- GIPSA-Lab (Grenoble)
- Heudiasyc (Compiègne)
- LAGIS (Lille)
- Pprime (Poitier)

Industrial

- Ademe
- Alstom transport
- Altim
- CEA
- Dantherm
- EIFER
- LITEN
- Pragma Industries
- Sintel
- Tornos (Switzerland)
- TRW
- ZSW

Issues

Predictive has to be preferred to corrective maintenance



⬀ safety

⬀ availability

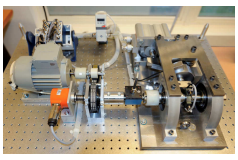
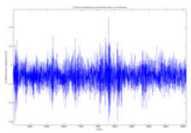
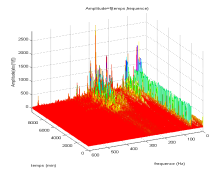
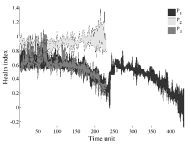
⬀ system useful life

⬂ exploitation costs

Observe

Objectives:

- gather useful data from the system
- de-noising and data characterization
- feature extraction/selection and health indicator construction

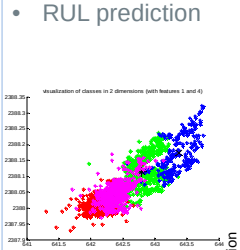
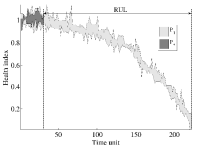
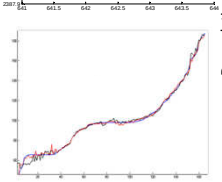
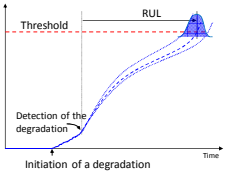





- ieee phm data challenge 2012
  http://www.femto-st.fr/en/Research-departments/AS2M/Research-groups/PHM/IEEE-PHM-2012-Data-challenge
- ieee phm data challenge 2014
  http://eng.fclab.fr/ieee-phm-2014-data-challenge/

Analyze

Objectives:

- uncertainty management
- degradation modeling
- health assessment
- RUL prediction

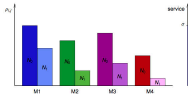
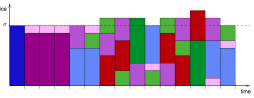
Fuel cell health state estimation in real conditions

Act

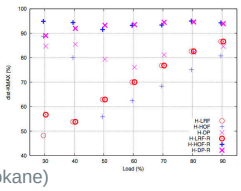
Objectives:

- managing the useful life of systems
- combinatorial problem
- mathematical complexity
- optimal or heuristic approach

	Homogeneous machines	Heterogeneous machines
1 running profile	$\rho_{i,j} = \rho$ MAXK($\sigma \mid \rho \mid RUL_i$) ⇒ polynomial	$\rho_{i,j} = \rho_i$ MAXK($\sigma \mid \rho_i \mid RUL_i$) ⇒ NP-complete
n running profiles	$\rho_{i,j} = \rho_i$ MAXK($\sigma \mid \rho_i \mid RUL_{i,j}$) ⇒ ?	$\rho_{i,j} = \rho_{i,j}$ MAXK($\sigma \mid \rho_{i,j} \mid RUL_{i,j}$) ⇒ NP-complete

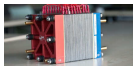



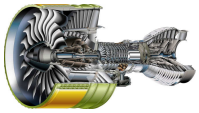
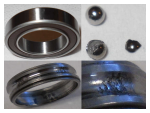
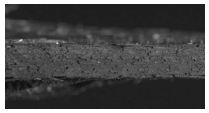
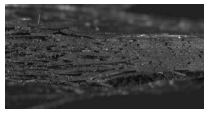
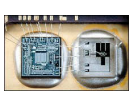
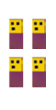
- multi-running profile scheduling



best paper award
(IEEE - PHM2014 - Spokane)

Applications



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