Acoustic Monitoring in Hydro Power Plants using clustering techniques

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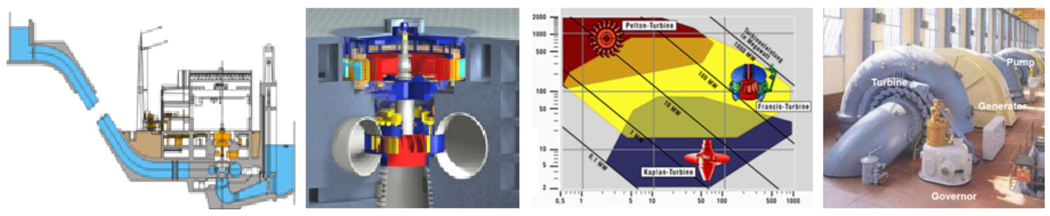
MOTIVATION

Classic monitoring systems in hydro power plants are based on expensive transducers providing information of only related equipment. Alarm static levels are based on international standards:

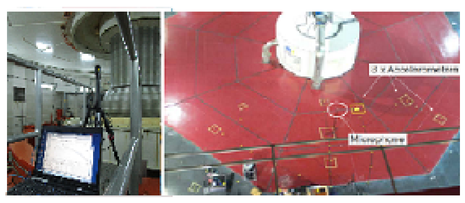
1. Expensive for a lot of power plants
2. Pressure to reduce cost increases as the price for energy is low
3. The majority of plants are unmanned. No inspection rounds
4. New monitoring systems should emulate human senses
5. Must known problems could be ”audible”
6. Industry focuses on reduce maintenance costs
7. Alarm levels should be related to unit health

Asset owners need to optimize their maintenance strategies to run a profitable business. Outside of the hydropower, ExxonMobile and Lockheed Martin[1] develop technologies collecting data to analyze by advanced algorithms: Machine learning should enable predictive maintenance in the future, transferring learnings from big data analysis from one plant to another. Finally, cloud based systems enable manufacturers to connect plants, adding additional value to each individual customer.



OBJECTIVES

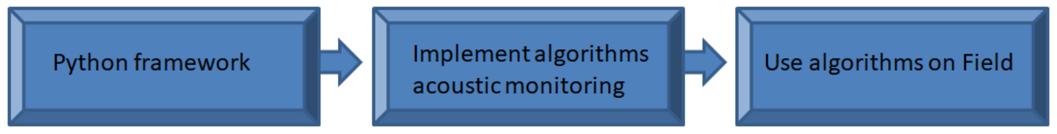
The main objective of the thesis is to develop a monitoring system based on acoustics capable to be used in hydro power plants, using machine learning algorithms and other analysis techniques. The first goal is to analyze data, by means of new methods based on the spectral structure of the power plant sound sources



1. Describing the main sources of noise
2. Correlating acoustic integral monitoring to vibration[2]
3. Establishing priorities for designing an acoustic monitoring system
4. Implementing algorithms for component sound recognition and clustering depending on operation classes
5. Safeguarding safety of these critical infrastructures follwing standards [3]

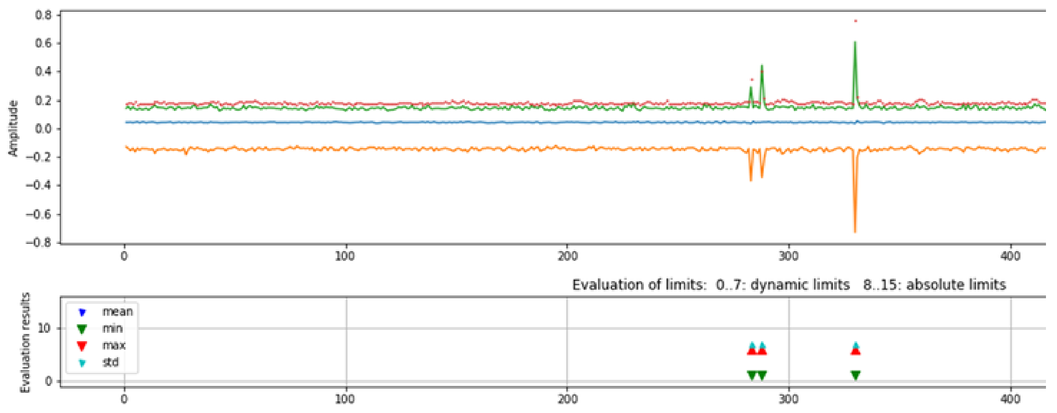
METHODOLOGY

Field tests will be implemented and compared with vibration fingerprint analysis for confirmation of the results.

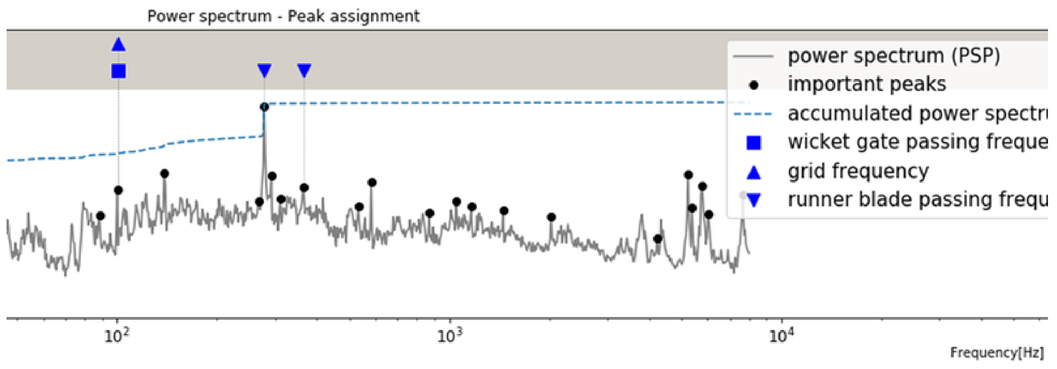


RESULTS

- Detection of first anomalies in power plant



- Accoustic anormal peaks in power plant



OUTCOMES

- The Python framework for the algorithms has been designed. Some algorithms have been implemented and tested.
- Measurements have been done under labor and field conditions
- HYDRO 2017 Conference Paper: Jose M. Nieto Diaz *et al.”Correlation between Vibrations and Acoustic Emissions of a Hydropower Plant”*

References

[1] Lockheed Martin ExxonMobil Awards Lockheed Martin Next-Generation Refining and Chemical Facility Automation System Contract Press Release, January 14, Spring, TX, USA, 2016

[2] Rati Kanta Mohanta, Thanga Raj Chelliah, Srikanth Allamsetty, Aparna Akula, Ripul Ghosh Sources of vibration and their treatment in hydro power stations Engineering Science and Technology, an International Journal (2017) 637-648

[3] NERC CIP 007 Systems Security Management Systems

RESEARCH PLAN AND FUTURE TASKS

Developed	2017			2018							
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Mai	Jun	Aug	Sep
Tasks	1	2	3	4	5	6	7	8	9	10	11
1. State of Art											
2.Design of framework											
3. Measurement Plan											
4. Implementation											
5. Tests											
HYDRO 2017											
6. Adapt. Algorithms											

Future	2018			2019							
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Mai	Jun	Aug	Sep
Tasks		1	2	3	4	5	6	7	8 (*)	9	10
1.Article Applied Energy											
1.Adapt. Algorithms											
2.Generalization											
3. Implementation											
4. Tests											
5. Cloud Clustering											
HYDRO 2018											