

Paris Session 2022



Cable protection system monitoring using DAS and machine learning

SC B1 INSULATED CABLES - PS2 - Q1

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Group Discussion Meeting

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Distributed Fibre Optic Sensing (DFO) and Cable Protection System (CPS)

- DFOS benefit
 - Smart load management / curtailment (DTS)
 - Fault localization (DAS, DTS)
 - CPS investigation (DAS)
 - Installation monitoring (DSS)
- CPS are failing in the field



Good CPS, marine growth

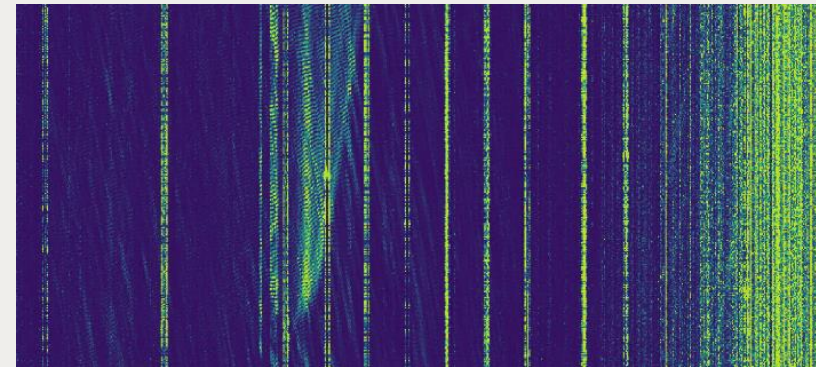


Bad CPS, no marine growth

- Different acoustic signature expected

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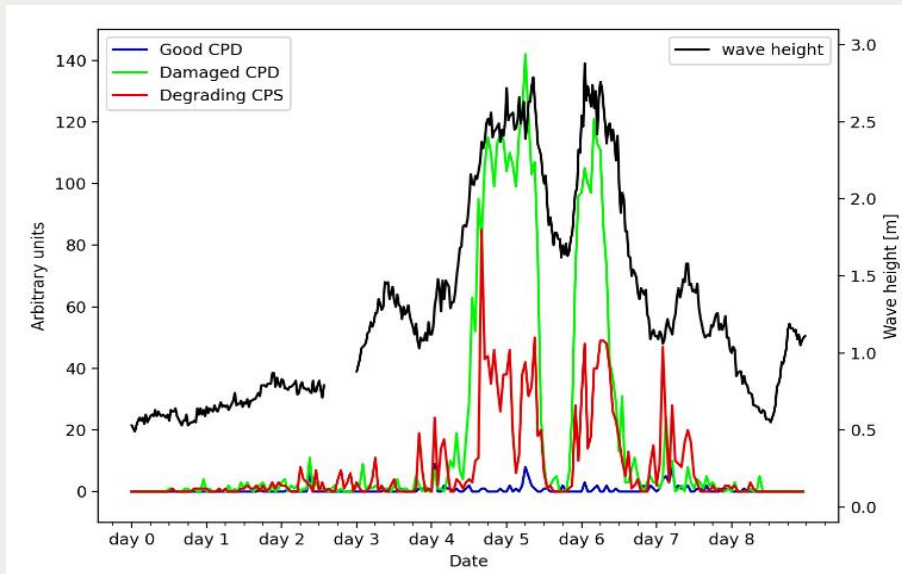
- Vibrations / movements can be measured using Distributed acoustic sensing (DAS)
- DAS generated amount of data not compatible with manual analysis



- Machine learning methods are mandatory

Distributed Acoustic Sensing (DAS) & Machine Learning (ML) for cable protection system investigation

- Unsupervised learning
 - Looking for anomalies
 - Validation with survey data



- Supervised learning
 - Confusion matrix for trained CPS test set

Training CPS		Prediction		
		Damaged	Degrading	Good
Label	Damaged	5	0	0
	Degrading	1	14	0
	Good	0	0	40

Annotations: A blue arrow points to the '0' in the 'Damaged' prediction column, labeled 'Missed damage'. A green arrow points to the '40' in the 'Good' prediction column, labeled 'Correct classification'. An orange arrow points to the '0' in the 'Degrading' prediction column, labeled 'False alarm'.

- Confusion matrix for unseen CPS (transfer)

New CPS		Prediction		
		Damaged	Degrading	Good
Label	Damaged	0	0	1
	Degrading	0	2	2
	Good	0	1	9

Conclusion

- DAS measurement campaign within inter-array cable
 - 9 months
 - 3 different strings measured, with 10 to 15 turbine each
 - 75 CPS
- Unsupervised and supervised ML
 - Good correlation between ML results in survey data
 - Unbalanced data set
- Next steps
 - Transfer to other strings
 - Transfer to other windfarms
 - Explore trends starting from installation to become free of survey information

Duruz et al: “Inter-Array Cable protection system predictive maintenance using Distributed acoustic sensing,” Windeurope Bilbao 2022, PO.091