



**€62 MILLION**

can be saved per year with  
predictive condition monitoring.

**Where are we NOW?**



# BASURAJ BHOWMIK, PhD

Postdoctoral Research Fellow, UCD

Basuraj is a researcher, lecturer and a civil engineer by profession. He has spent the better half of a decade in pursuit of *online monitoring* – both condition and health – of infrastructures and machineries. Basuraj has experience in vibration-based monitoring of gas turbines, early detection of wind turbine downtimes and accurate damage identification for our built infrastructure – the roads and bridges. His Postdoc at Dynamical Systems and Risk Laboratory, UCD has honed him with both managerial and entrepreneurial skills. Basuraj strives to make the world a little better by quantifying risks and swiftly detect damage, allowing people to sleep stress-free!



**VIBRATIONS**

**STRUCTURAL HEALTH MONITORING**

**BRIDGES**

**MOBILITY**

**MACHINE LEARNING**

**DATA TRANSMISSION**

**CITY SYSTEMS**

**REAL-TIME ANALYSIS**

**SENSORS**

**COMPUTATIONAL DEMANDS**

**SMARTPHONES**

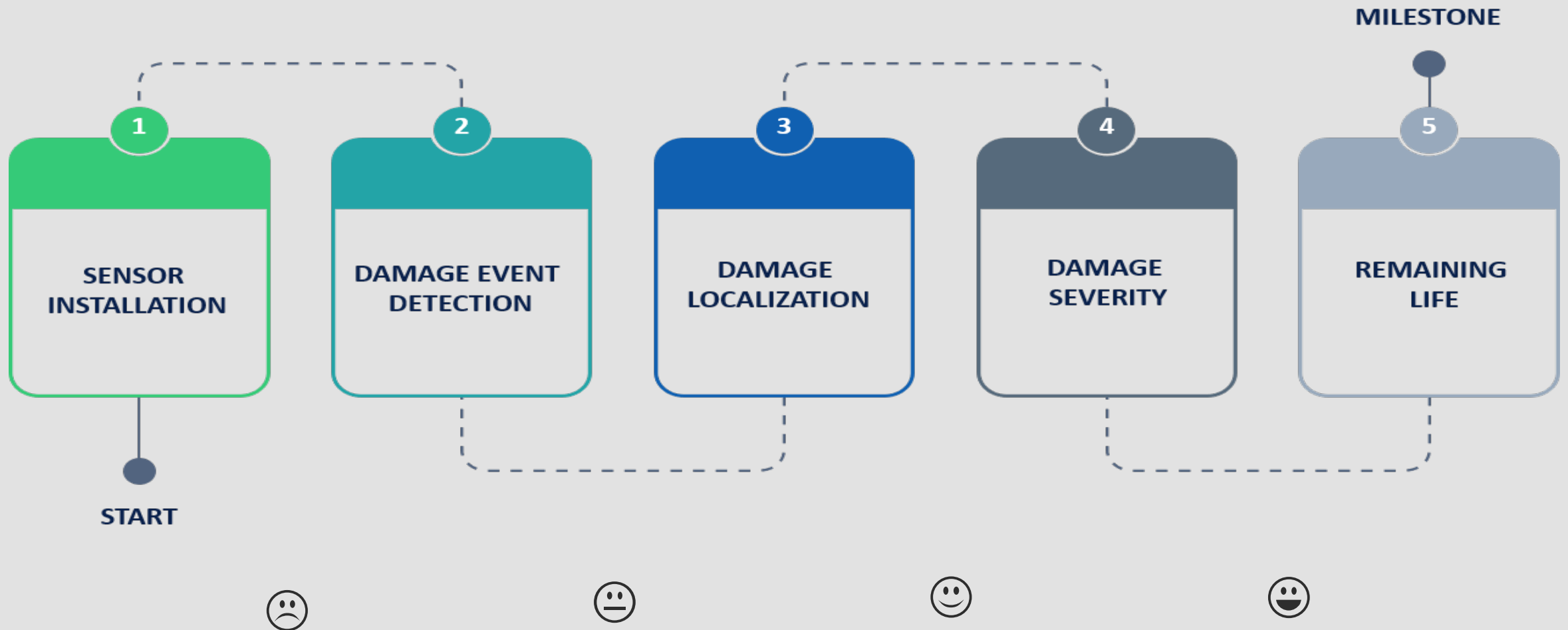
**BUILT INFRASTRUCTURE**

**HARDWARE ARCHITECTURE**

**ACQUISITION**

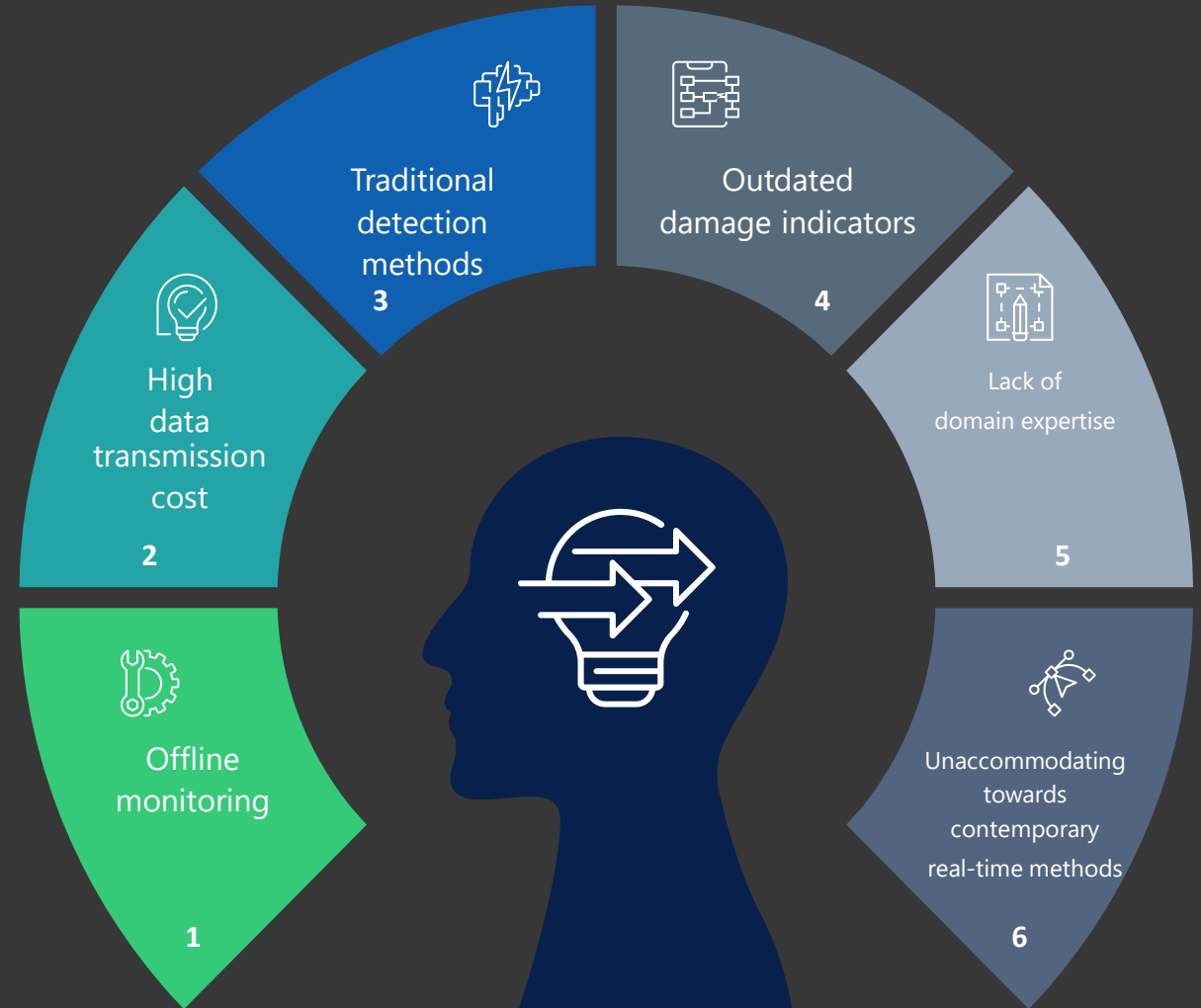
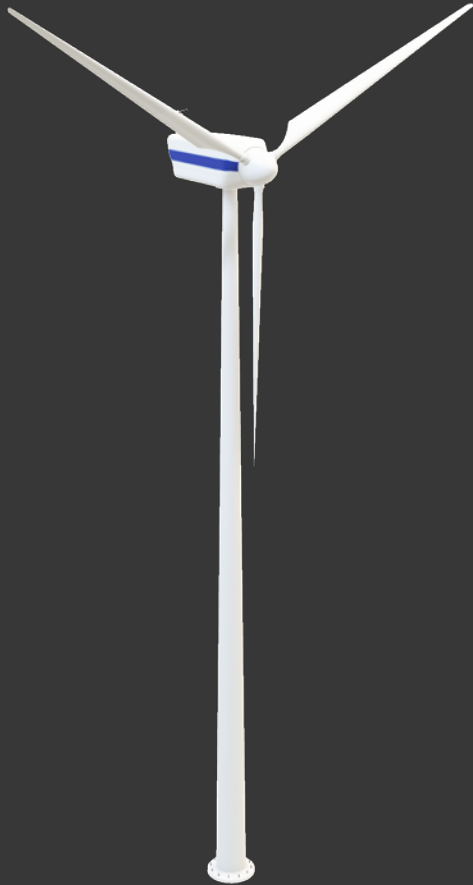
**MACHINE LEARNING**

# Vibration-based monitoring – The Machine ‘Doctors’



**Steps in vibration-based monitoring**

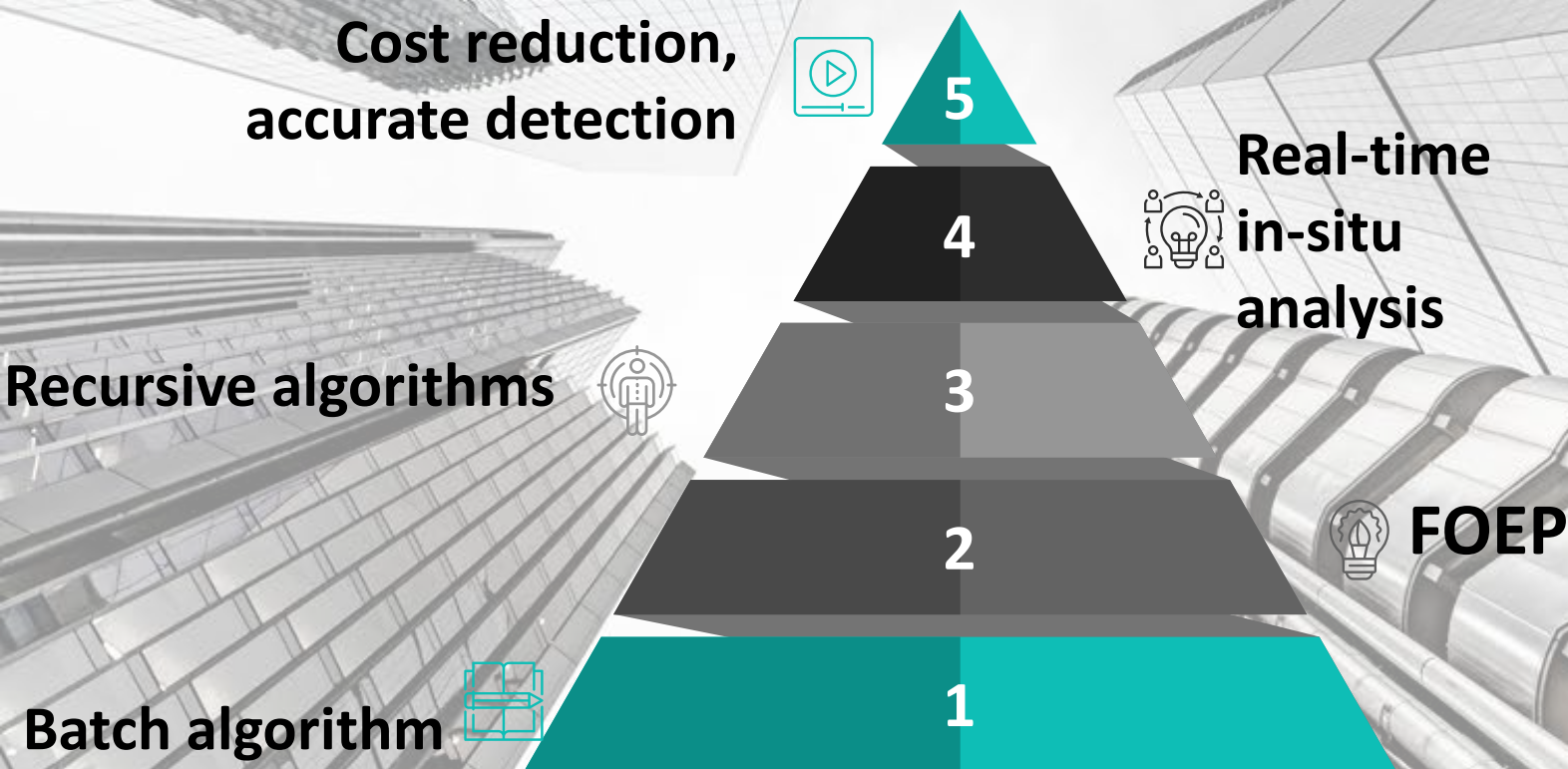
# Existing problems in SHM



One-stop solution – Real-time monitoring through **FOEP**



## 'HOW' IS REAL-TIME SHM DONE?



Machine monitoring – immediate need, with rising power generation concerns



Faster, non-contact, non-destructive testing methods, without hassle



Expertise to ensure structural health monitoring (SHM) needs



Low-cost real-time in-situ analysis







## DAMAGE DETECTION – ‘HOW’?



Check trend of DSFs



Use DSFs



Apply FOEP for transformation

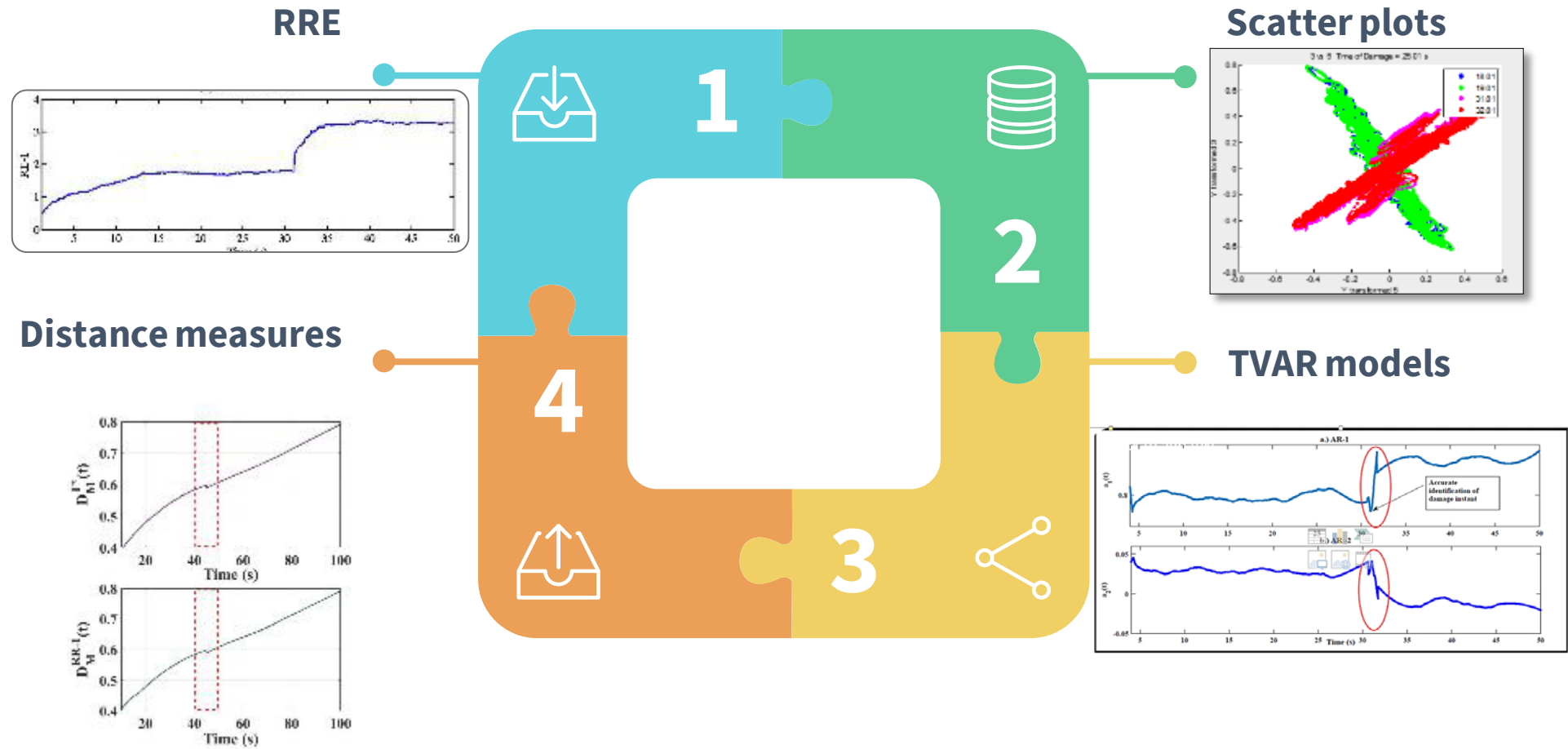


Extract physical response  
(strain, acceleration)

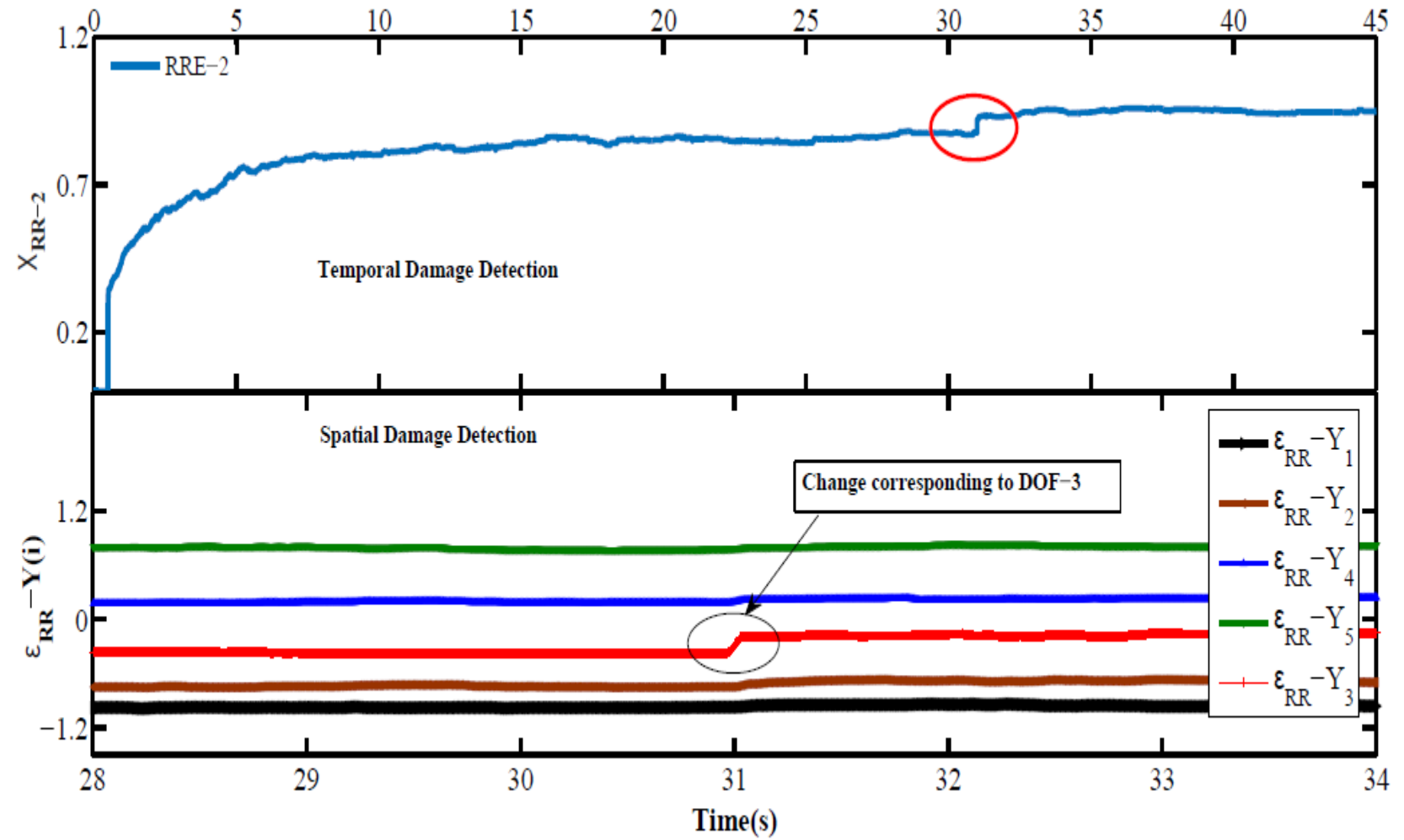
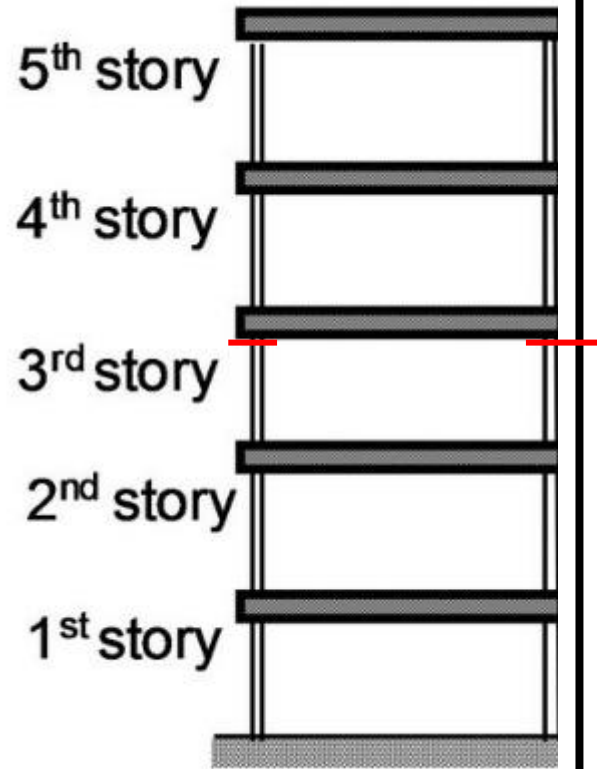




# Damage sensitive features – Our ‘little’ helpers

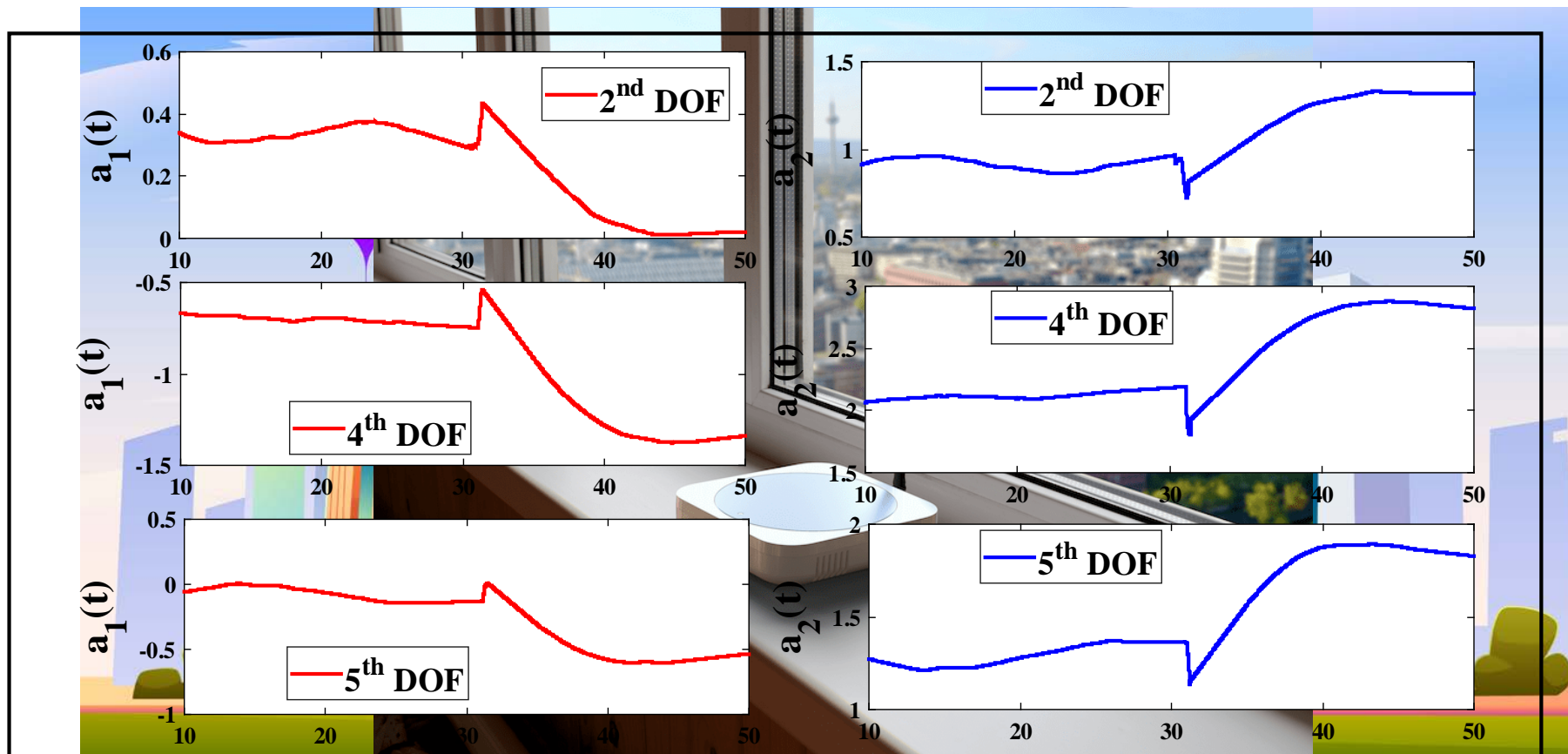


# Spatio-temporal damage detection results





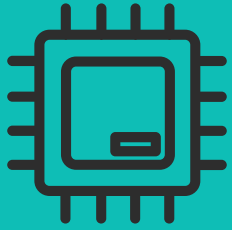
# Single sensor detection – Too good to be true?



<https://www.freepik.com/free-photos-vectors/business>'>Business vector created by upklyak - [www.freepik.com](http://www.freepik.com)</a>

# PRACTICAL CONSIDERATIONS

SENSOR



DECISION-  
SUPPORT



MIN INVESTMENT  
MAX SAFETY



FASTER  
DETECTION

DATA ANALYSIS

PERFORMANCE PREDICTION

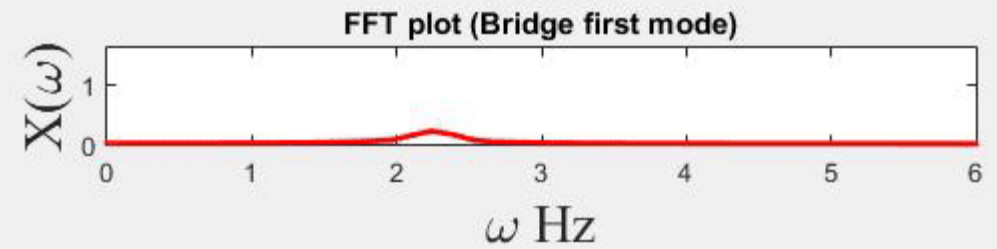
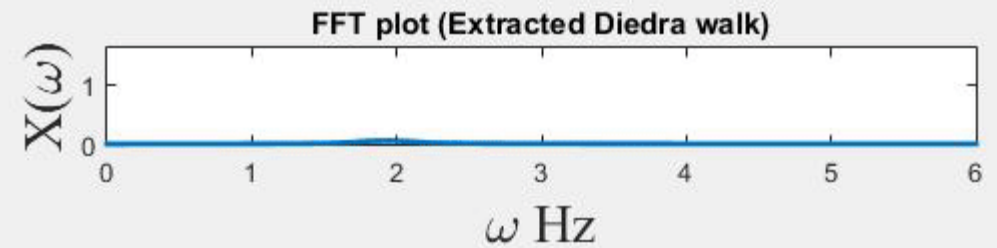
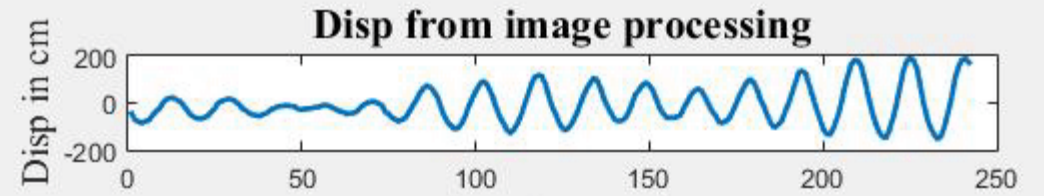
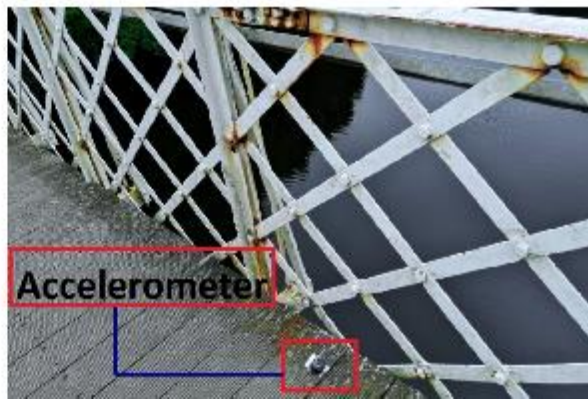
DOMAIN ADAPTATION





# ONLINE MODE SEPARATION

Camera focused at the mid-span of the bridge



# BUSINESS MODEL & MARKET OPPORTUNITY



## INDIVIDUAL LICENCE

SHM software and analytics modules adapted to specific domain-needs; One-off lumpsum solution development of new software and analytics suite



## ANNUAL INTEGRATED LICENCE

Licence-bundles for complete software and algorithmic solutions with instrumentation strategies, data interpretation and decision-making scenarios for a range of needs within a sector; annual maintenance of solutions

TAM

**\$2.4B**

SAM

**\$200M**





**September – 3, 2019 : South America**

**This could have been prevented**

**TURBINE BLADE – CONTROL SYSTEM  
FAILURE**

## Acknowledgements



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