FOWT2017
Floating Offshore Wind Turbines

New method for Integrity Management

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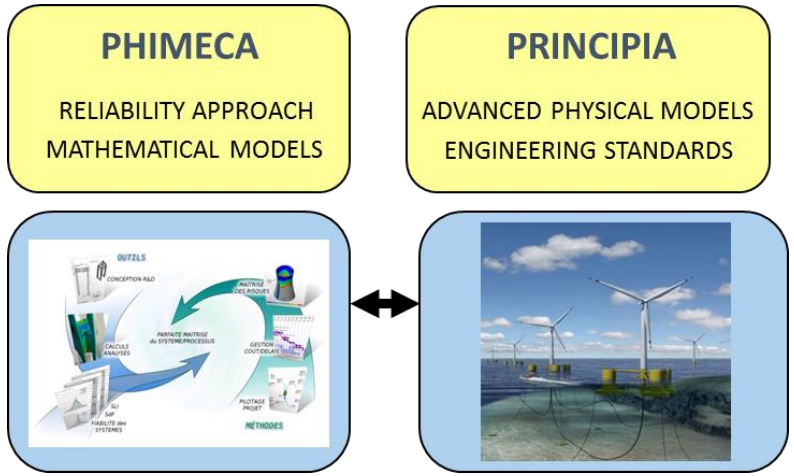
PHIMECA
Solutions for robust engineering

PRINCIPIA

Context

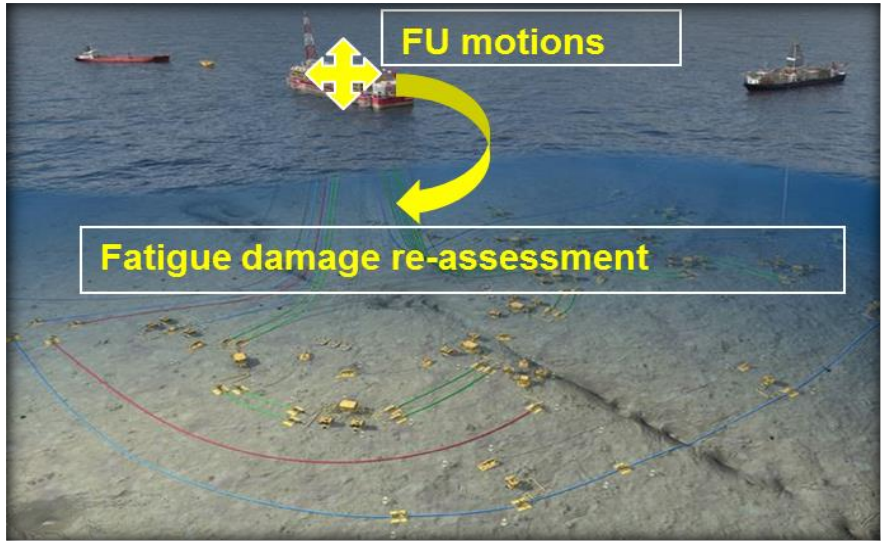
- Long term collaboration between **PHIMECA** & **PRINCIPIA**
- R&D work sponsored by **TOTAL** for risers monitoring
- Based on REX from complex monitoring systems

➔ Method to control the fitness-to-purpose of risers with only the floater's motions



- The method presented here is a fruitful compromise:
  - ➢ The limited complexity/cost of the monitoring
  - ➢ The findings are valuable

➢ May help reducing risks for new concepts of FOWT



Method main principles

Phase 1: Training phase

- Build a concise representation of motions through signal processing and statistical analysis of the available recordings
- Approximate the physical model by a fast meta-model built with an optimized sample of recordings
- Elaborate a probabilistic model for simulation of motion over long periods of time

Phase 2: Prognosis and update phase

- Process thousands of replications of motions with the associated damage
- Derive a precise Lifetime prognosis as well as uncertainty estimation

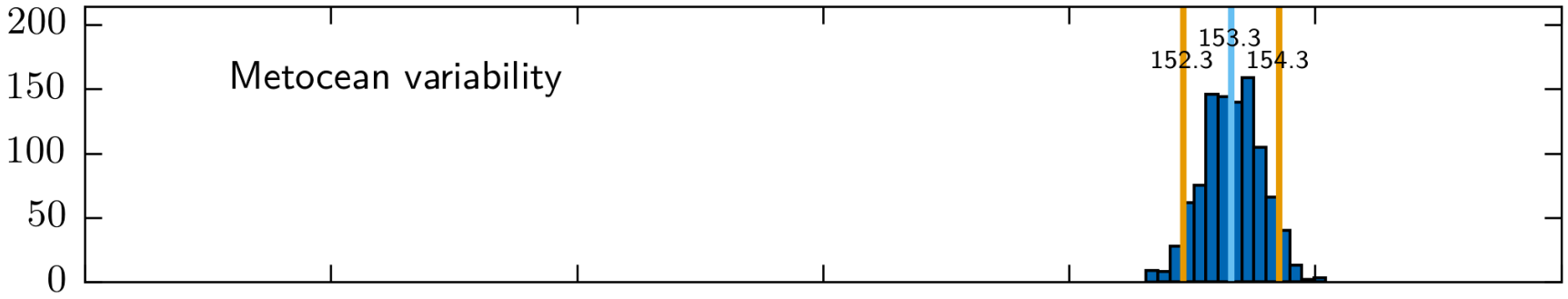
➢ Once on board:

- *Incoming data feed the database for updating the motion probabilistic model*
- *An alert is triggered in case of large deviation from the training sample (→ go back to phase 1)*

Method validation

- The methodology has been numerically validated for a riser case (AKPO SCR):
  - 1000 complete sea-states (3h) derived from meteocean specifications
  - A complete fatigue analysis is performed with the physical model ➔ Lifetime = 154 Years
  - The method is applied considering the FPSO motions as in-situ recordings

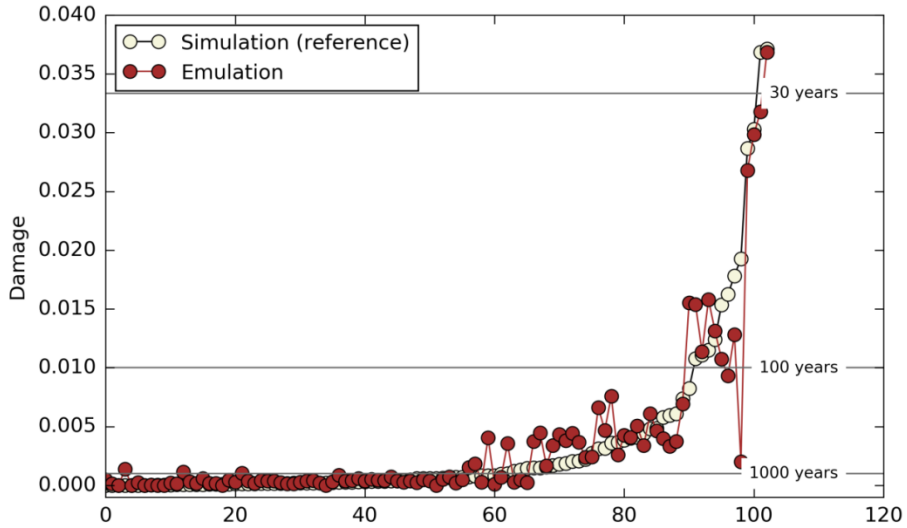
95% confidence Lifetime [152.3, 154.3] Yrs



- This method is now being applied on MOHO project with real recordings

Test case of a FOWT

- Method applied on FOWT real case
- Focus is put on mooring lines fatigue (incl. Production and idle cases)
- PHASE1 : FOWT motions concise representation
  - After optimization, reduced to only 2 parameters!
  - i.e. Every motions recording may be represented by 2 coordinates (Factor1, Factor2)
- PHASE 2: Meta-model Damage = fct(Motions)
  - built from DeepLines WIND fatigue results
  - Global Fatigue life: 168 Yrs (Emulator) vs 176 Yrs (Reference)

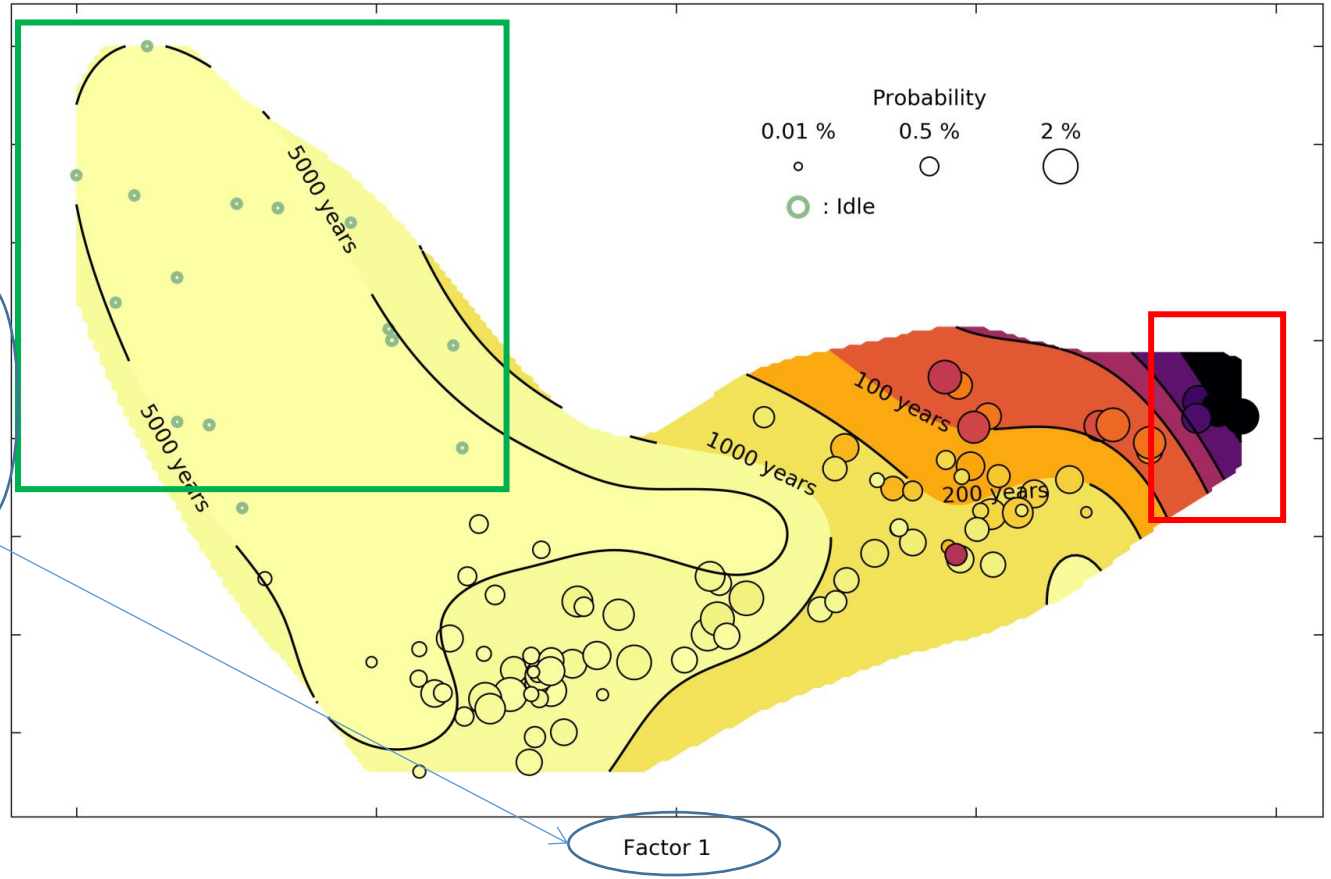


Test case of a FOWT

- **In that specific case, cartography Damage = fct(Factor1, Factor2)**

IDLE cases:
- High factor 2
- Low damage

Motions coordinates in the concise representation frame



Most severe production cases:
- High Factor1
- High damage

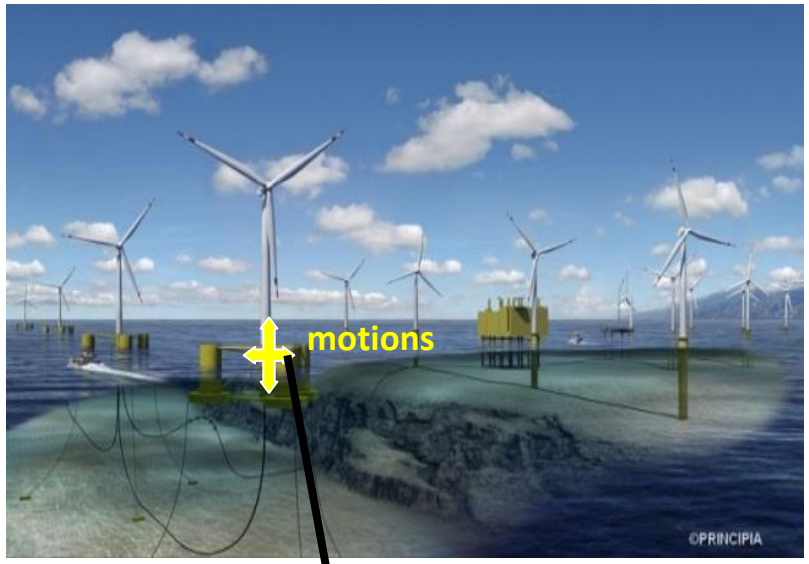
Conclusions

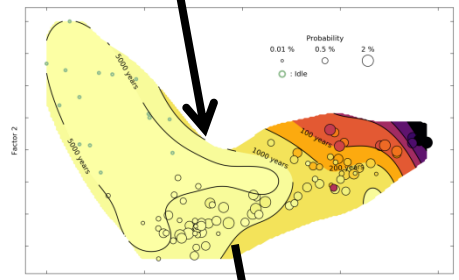
- This method may be implemented to follow-up the integrity of all systems mainly impacted by Floater's motions

Major assets:

- Limited monitoring system on board: Floating Unit Motions
- Prognosis and update phase is quite fast (few seconds)
  - ➔ day to day follow-up is possible,
  - ➔ Warning messages: detection of unexpected behaviour

- May help reducing risks for new FOWT farms





- **Day-to-day damage re-assessment**
- **Warning statement**