

Monitoring Mooring Systems

—
FER Forum
Nov/24

Lucas Castelli

Agenda

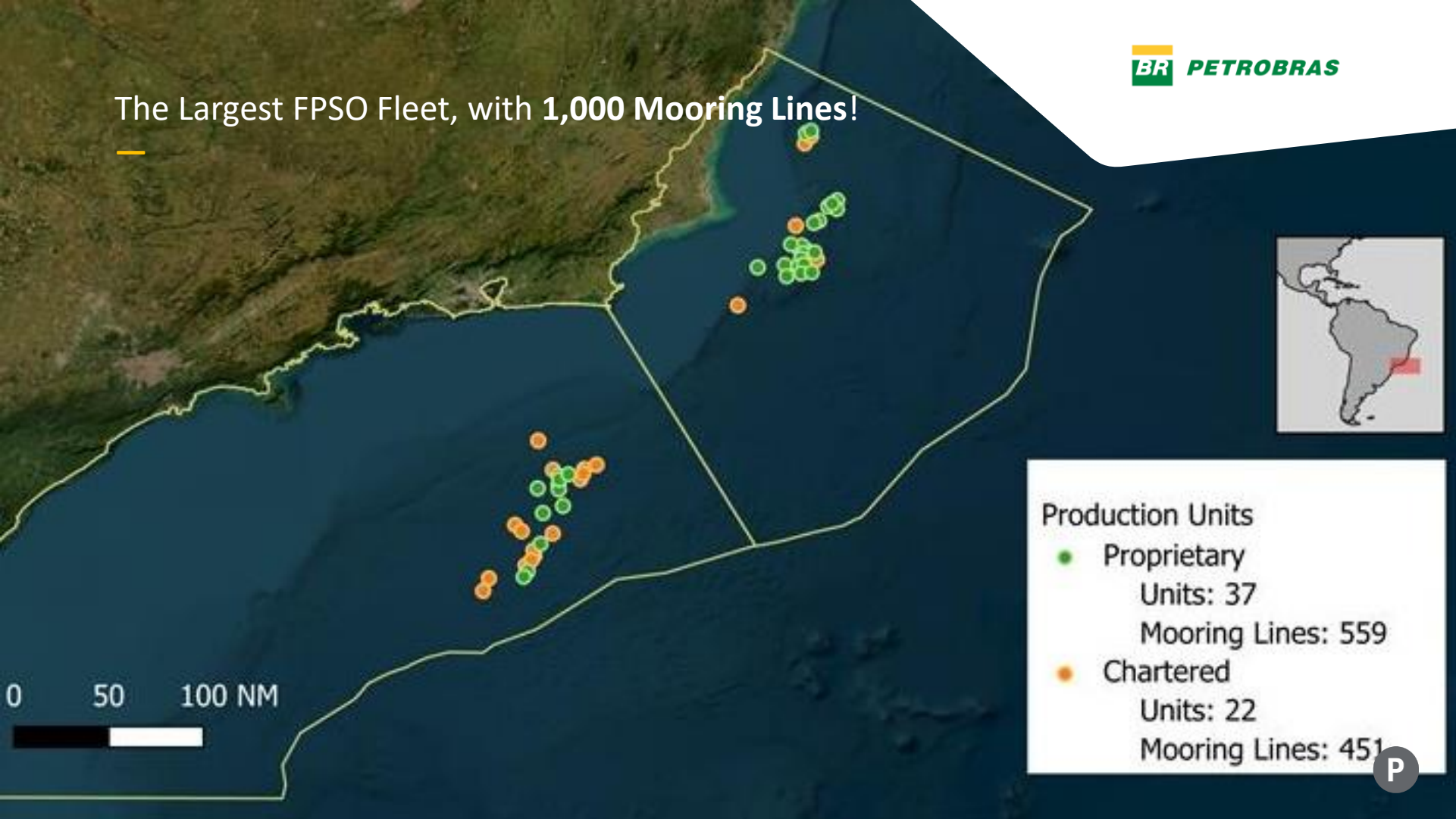
The background of the slide is a dark blue aerial photograph of an oil tanker ship at sea. The ship is large and complex, with many pipes and structures visible on its deck. It is moving towards the right, leaving a white wake behind it. In the upper left corner, there is a small yellow horizontal line.

- Contextualization
- Monitoring Applications
- Final Remarks
- Partners

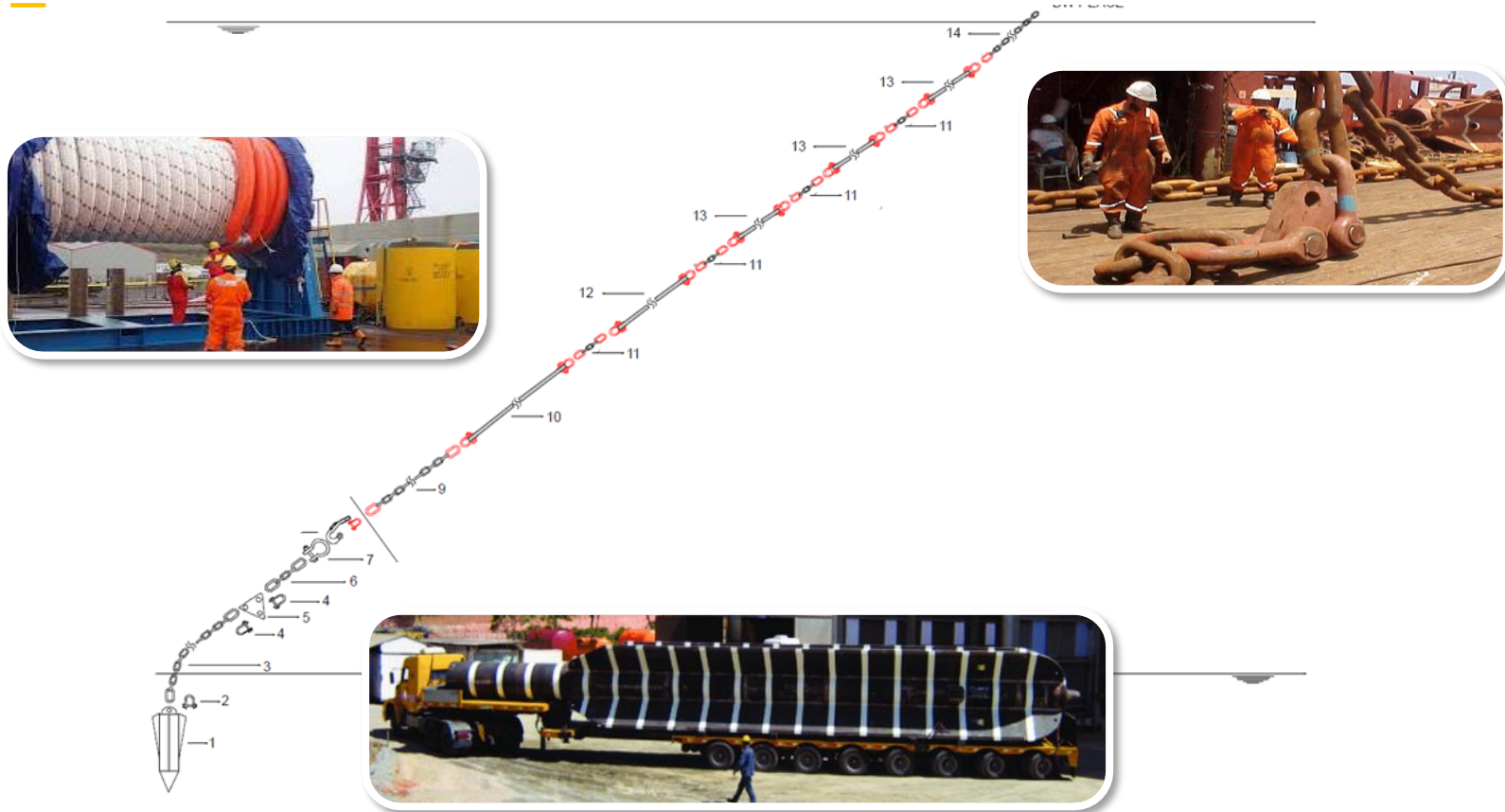
Contextualization



The Largest FPSO Fleet, with 1,000 Mooring Lines!



Back to Basics



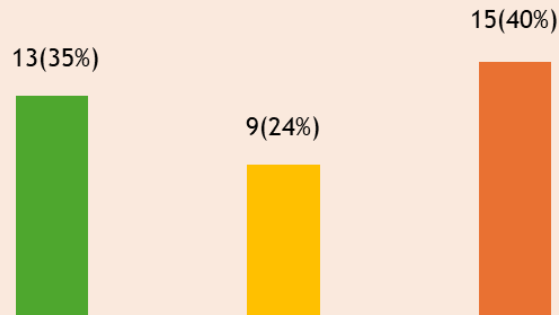
Show must go on!

Our production
2,69 MM BOE/day



**LINE FAILURE STOPS
PRODUCTION!**

N° of Unit x Petrobras fleet age

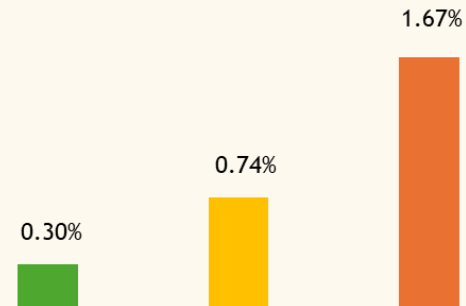


Up to 10 years

10-20 years

Over 20 years

Failure rate x Operating Time



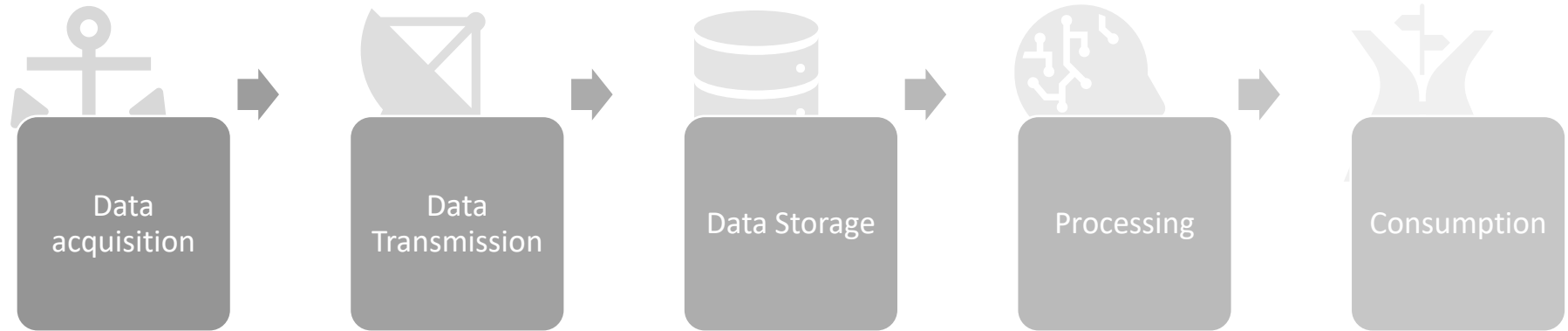
Up to 10 years

10-20 years

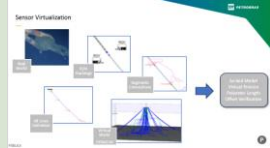
Over 20 years

Monitoring Applications


From Offshore to decision making



Several Applications





**SENSOR
VIRTUALIZATION**




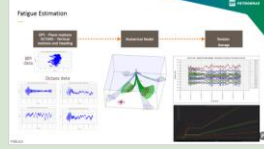

**DATA
VISUALIZATION**





**INTEGRATED
ANALYSIS**

**FAILURE
DETECTION**

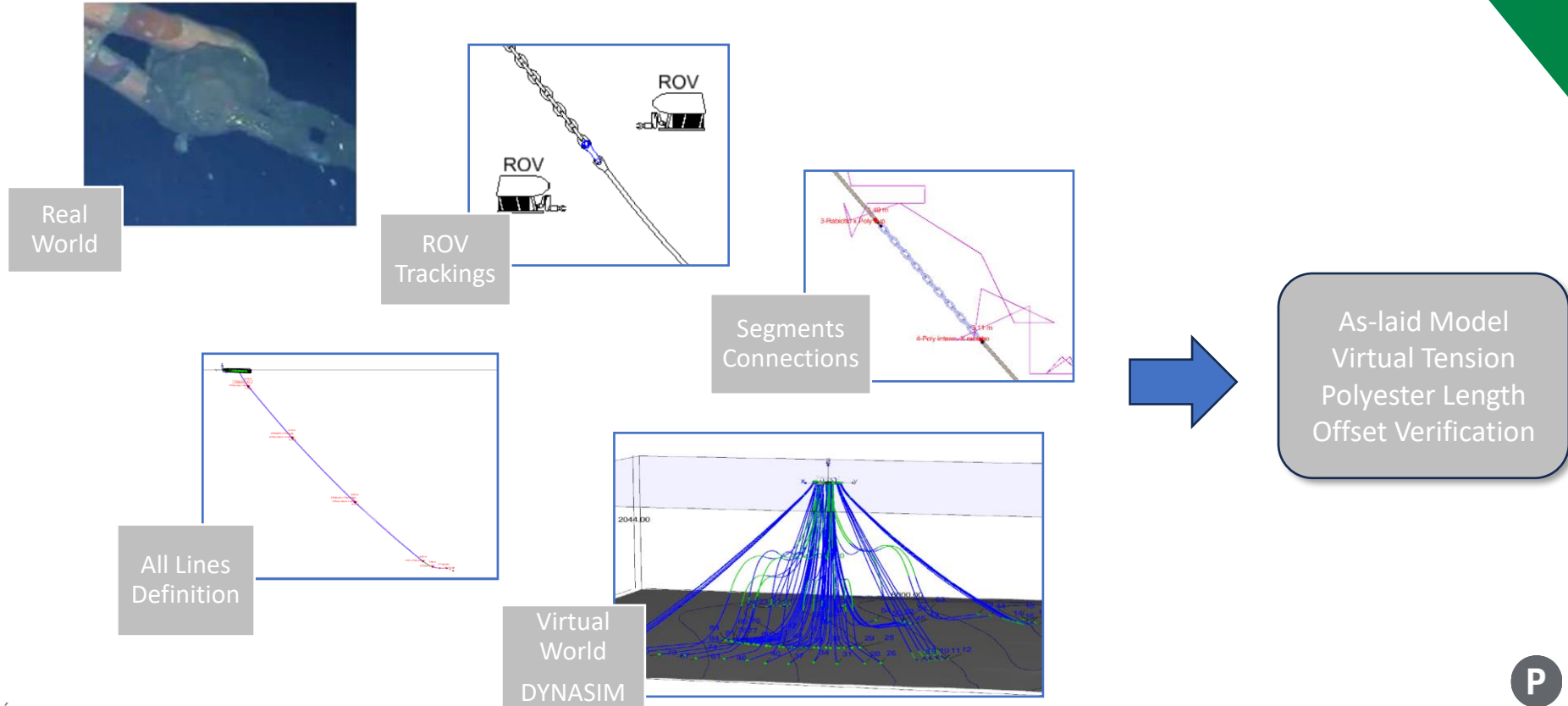
**FATIGUE
ESTIMATION**




**INTEGRITY
MANAGEMENT**



Sensor Virtualization



Data Visualization

Anytime, Anywhere,
to Anyone
Sensors, Inspections
and Calculations



Control Room Overview Onboard Screen sample



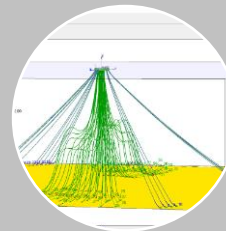
Positions



Motions



Environmental
Conditions



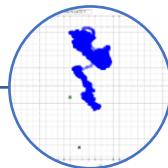
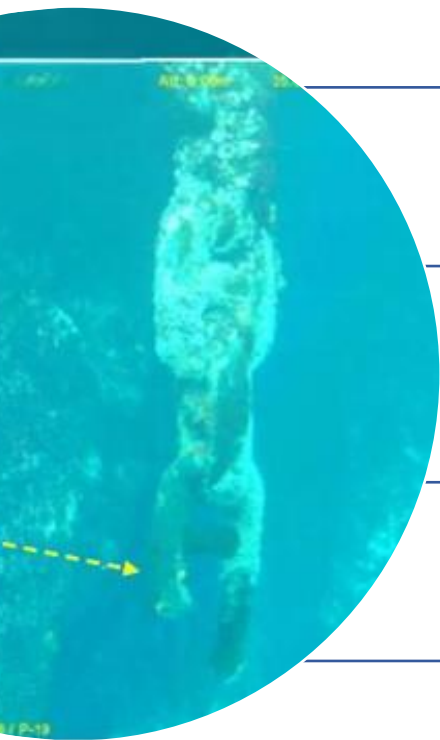
Virtual Model



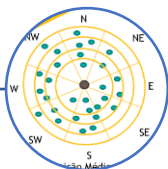
Simulations for
Design,
Emergencies
and Life
Extension



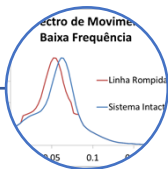
Failure Detection



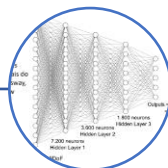
OFFSET
100% IMPLEMENTED



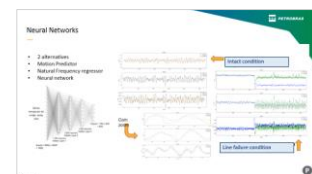
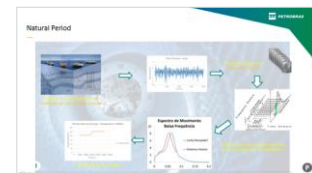
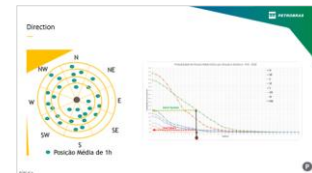
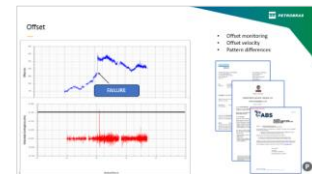
DIRECTION
UNDER DEVELOPMENT



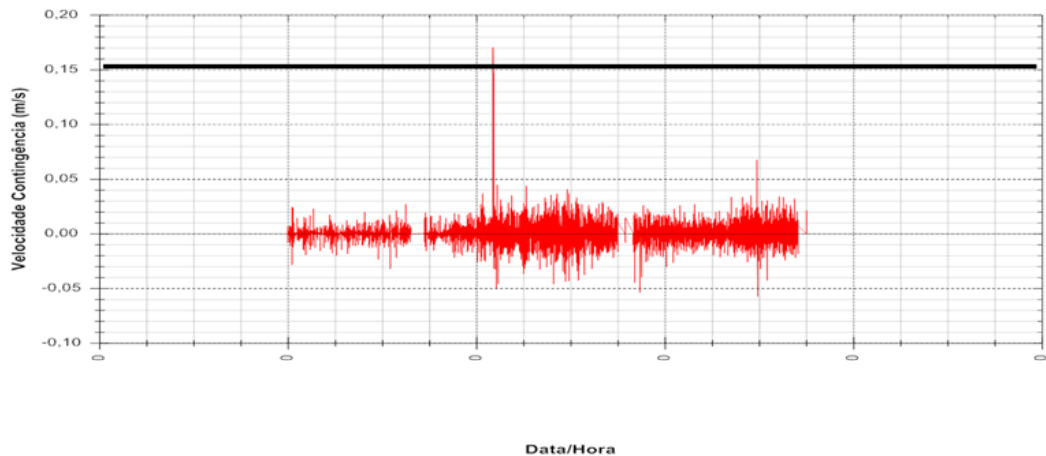
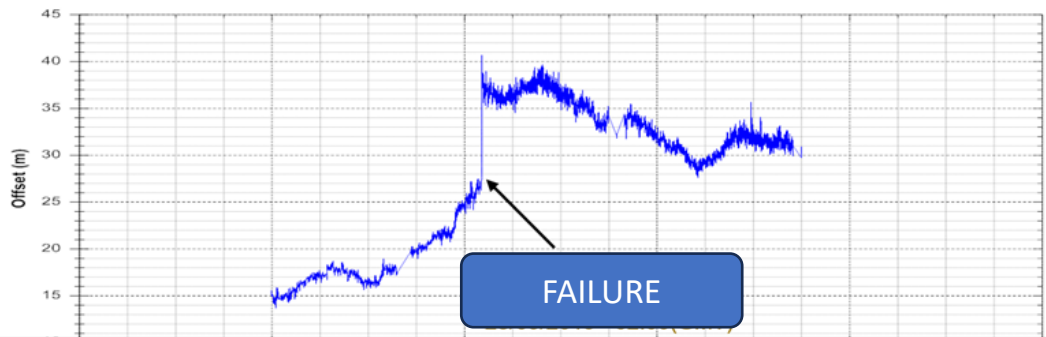
NATURAL PERIOD
UNDER DEVELOPMENT



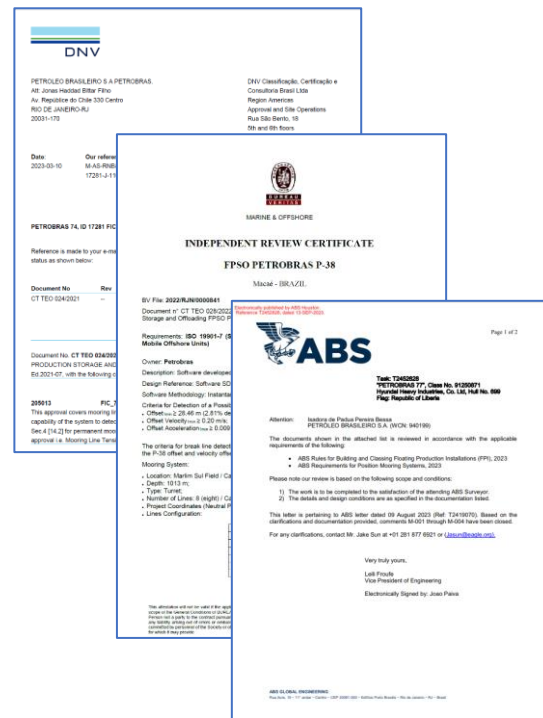
NEURAL NETWORKS
UNDER DEVELOPMENT



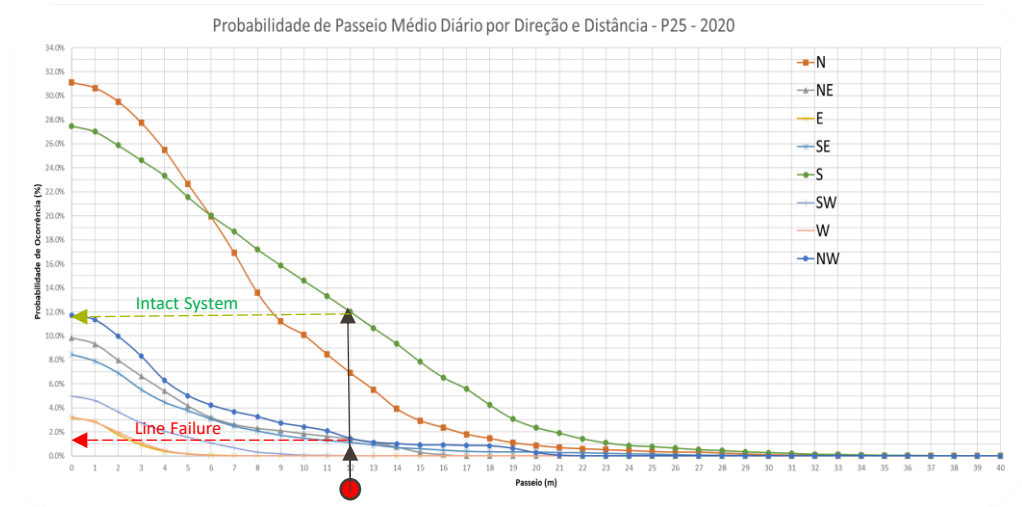
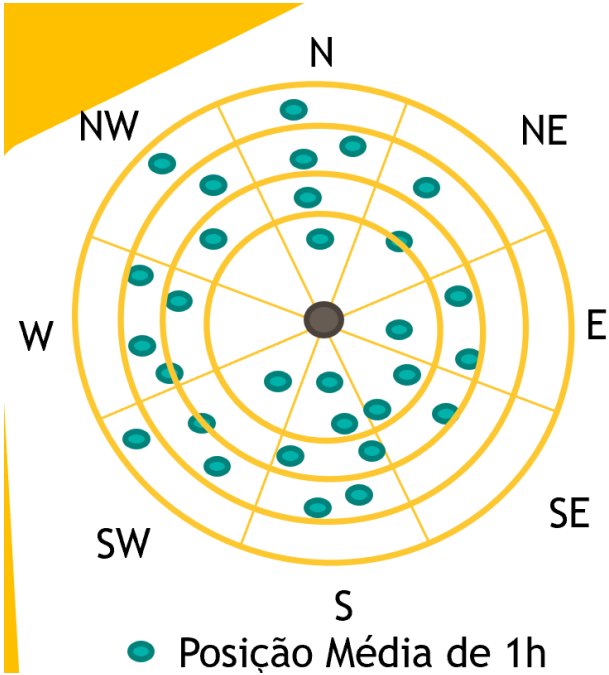
Offset



- Offset monitoring
- Offset velocity
- Pattern differences



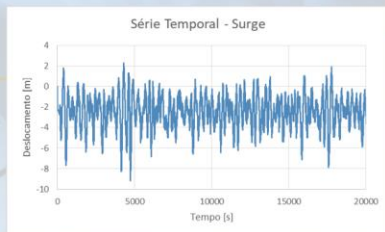
Direction



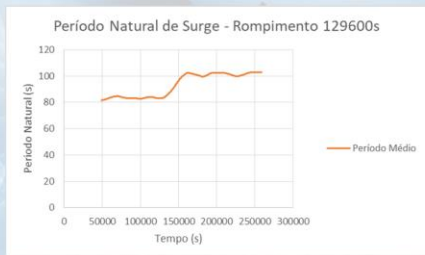
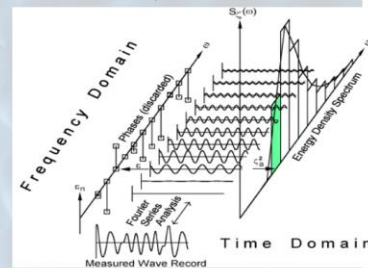
Natural Period



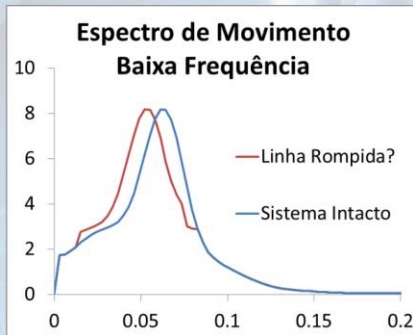
Registro e Armazenamento de históricos de movimentos medidos



Geração de Espectros aplicando Fourier



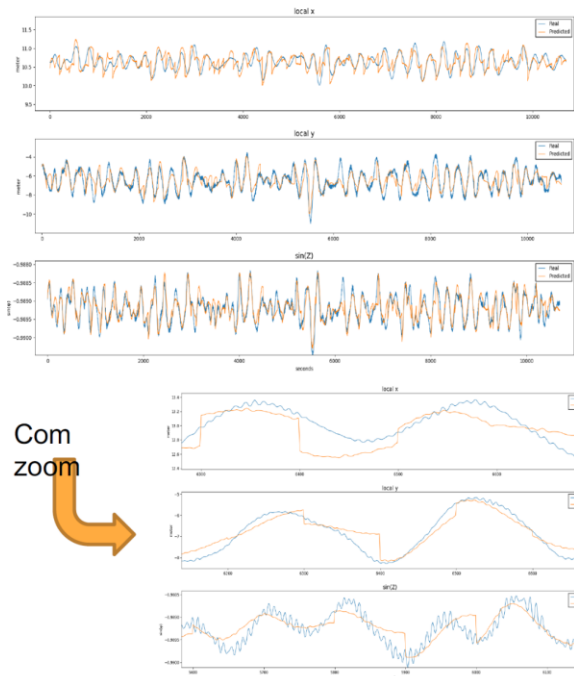
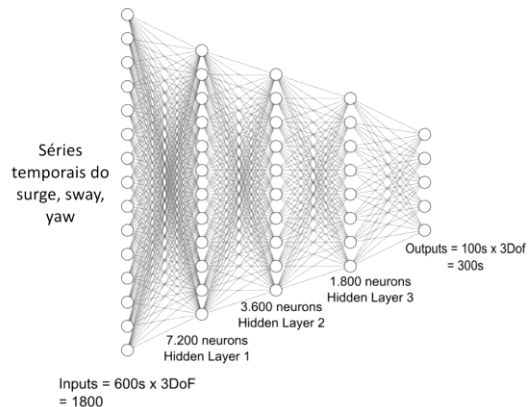
Período Natural x Tempo*



Identificação dos Períodos Naturais através do espectro de Movimento

Neural Networks

- 2 alternatives
- Motion Predictor
- Natural Frequency regressor
- Neural network



Intact condition

Line failure condition

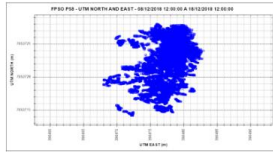
Fatigue Estimation

GPS - Plane motions
OCTANS - Vertical
motions and Heading

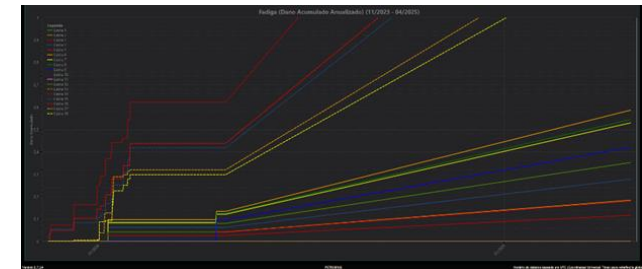
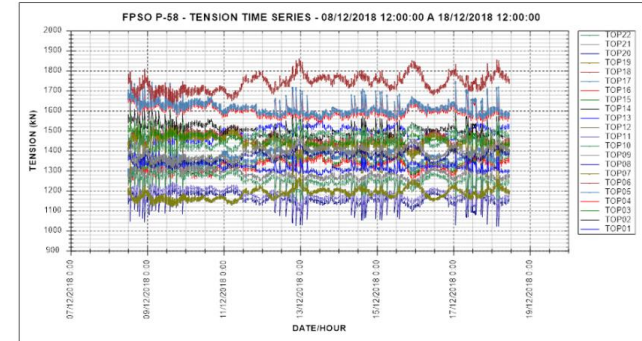
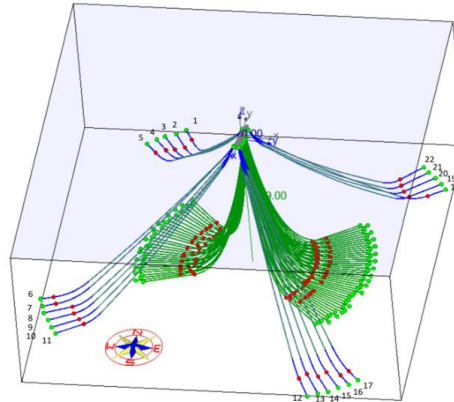
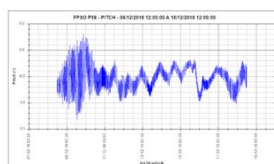
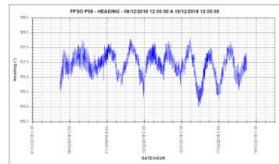
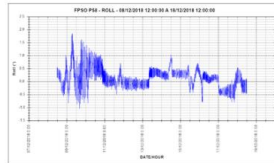
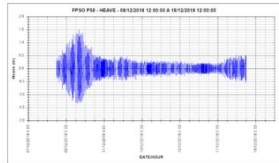
Numerical Model

Tension
Damage

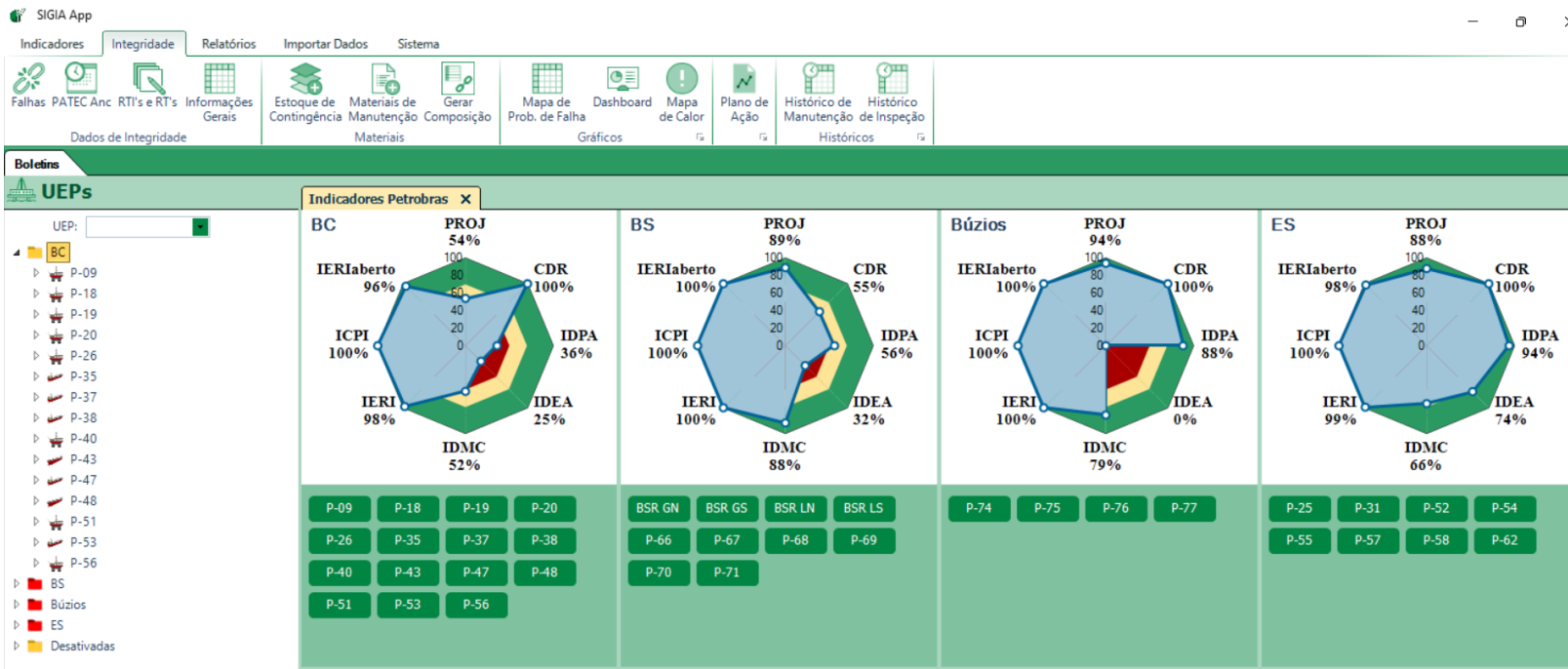
gps
data



Octans data



Integrity Management



Final Remarks

Benefits

- Improved Reliability
- Emergency Readiness
- Single Source of Truth
- Cost reductions

Pain points!

- Modularity and **INTEROPERABILITY** is a must
- The results depends on **SENSOR DATA** quality
- AI and Digital Solutions will **ENHANCE** human capabilities
- ***STATUS QUO*** is the biggest challenge
- Deal with **LEGACY** with reasonability

Partners



Partnership Ecosystem



DNV



UFRJ
UNIVERSIDADE FEDERAL
DO RIO DE JANEIRO



COPPE
UFRJ



UNIVERSIDADE FEDERAL
DE ALAGOAS



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