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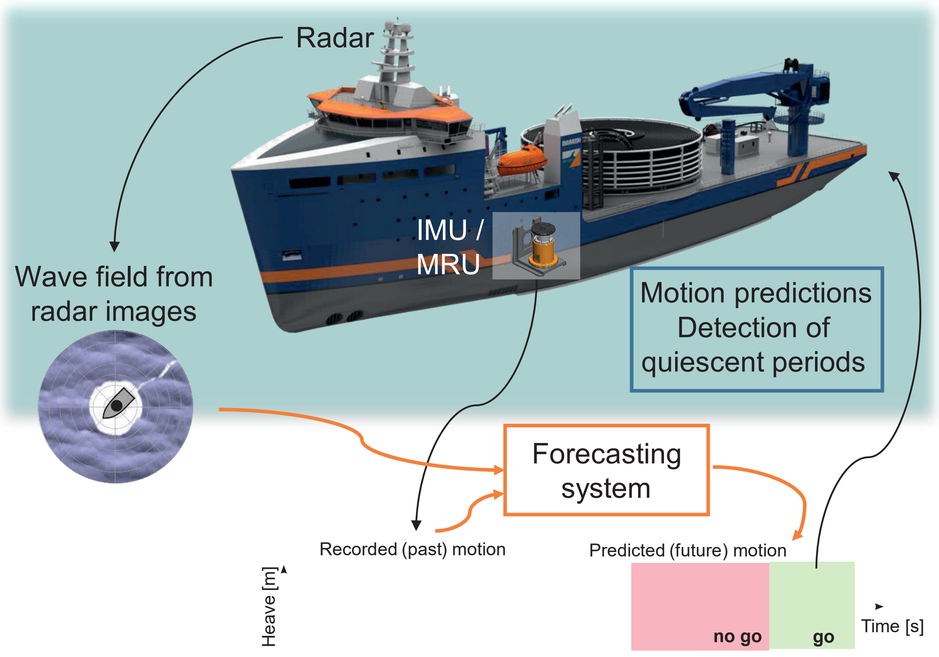
Poster n°22

Real-time wave forecasting from remote sensors for offshore operations

CONTEXT

IFPEN work on **real-time wave forecasting**:

- Forecasting time series of wave elevation, wave excitation force, ship motion, etc..
- Up to several minutes into the future.
- Based on measurements updated in real time.
- Wave-to-wave (≠ sea state forecasting).



Via the innovative, patented **SBP approach**, which allows to exploits at best **remote sensors** such as X-band radars, lidars and stereoscopic cameras.

APPLICATIONS

Decision support systems for offshore operations:

- transfer and ship-to-ship,
- lifting and drilling,
- ROV and helicopters …

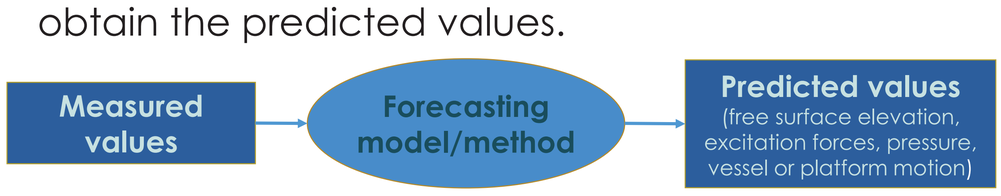

increasing safe operating limits and uptime.

Model predictive control (wave energy converters, heave compensation systems, floating wind turbines).

STATE OF THE ART VS. INNOVATION

Deterministic point of view (state of the art)

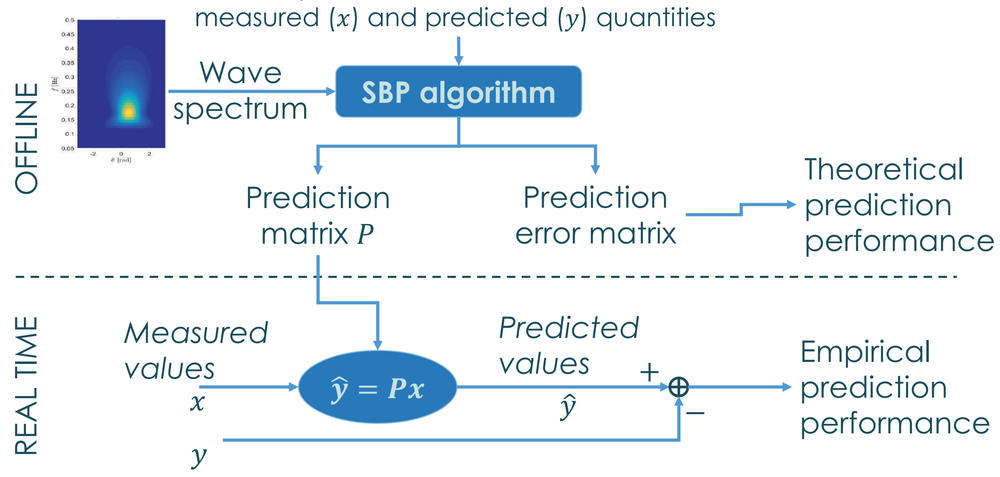
- Identify a finite number of wave modes based on measured values.
- Propagate those wave modes in space and time to obtain the predicted values.



Stochastic point of view (innovation @ IFPEN)

- The wave field is made of an infinite number of independent wave modes ⇒ the sea is random and mainly Gaussian.
- Wave fields are best treated as random processes.

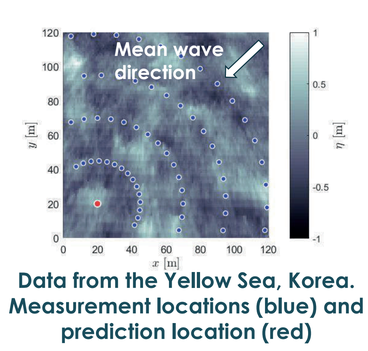
SPECTRUM-BASED PREDICTION



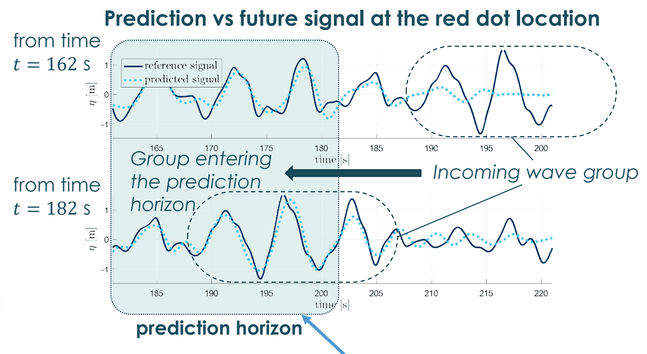
Benefits of the SBP approach:

- Compatibility with real-time requirements.
- Ability to provide confidence levels.
- Ability to optimally combine any type and configuration of available measurements.

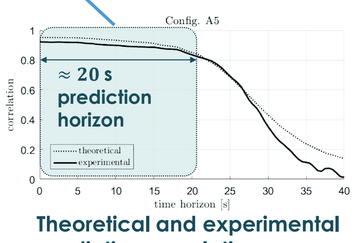
SAMPLE RESULTS ON STEREO DATA



Data from the Yellow Sea, Korea. Measurement locations (blue) and prediction location (red)



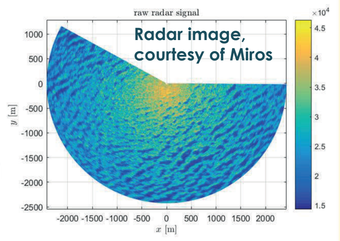
- Taking measurements from a square of only 120 m,
- 20 s-ahead predictions are accurate enough for decision support in transfer operations.



Theoretical and experimental prediction correlation curves

PERSPECTIVES

IFPEN's current focus is on **X-band radars**, with a much longer range, to extend the forecasting horizon up to a few minutes, thus enabling decision support for longer operations.



REFERENCES

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A. MÉRIGAUD AND P. TONA, "*Wave-by-wave forecasting: What do we need?*". 17th International Waves Workshop, University of Notre Dame, USA, 2023.

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