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Usage of distributed computing system in the recovery of the spectral density of sea waves

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Outline

- Introduction
- The problem
- The solution
- The features of the solution
- The software structure

Introduction

- State of the problem (Nechaev, 1990)
- First full scale tests (Nechaev, 1991-1992)
- Including in on-board intelligence systems (Nechaev, Degtyarev, 1996-1998)
- Bayesian approach (Iseki, 2001, Nielsen, 2008)
- Combination of different sources for wave identification improvement (Nechaev, Degtyarev, 2005)
- Kalman filter application (Pascoal, 2009)
- Works about wave spectra identification and integral characteristics determination (Simons, 2010, Nielsen, 2011, etc.)

The problem

$y''(t) + a \cdot y'(t) + b \cdot y(t) = \zeta(t)$ – the linear equation of pitching

The theorem of Khinchin:

$$S_y = |\Phi_{xy}(\omega)|^2 S_x$$

S_y – the spectral density of the output stream

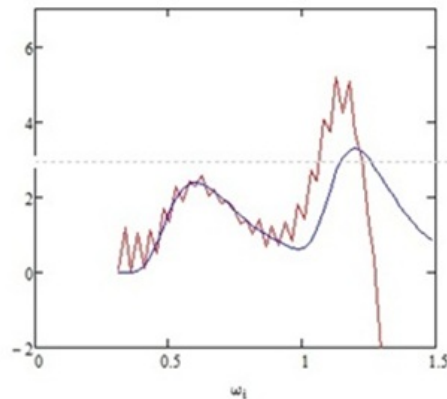
$\Phi_{xy}(\omega)$ – the transmission function

S_x – the spectral density of the input stream

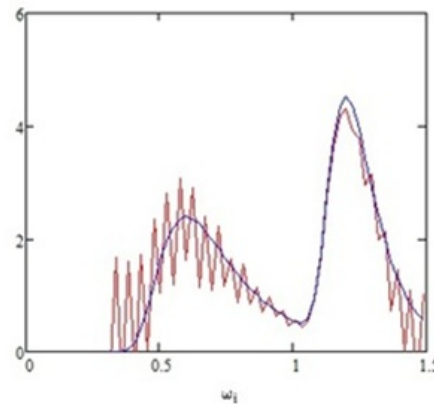
The solution

The solution is the following:

1. Read the acceleration data on the sides and determine the linearity of the process.
2. Read the data of different types of pitching.
3. Calculate S_y – the spectral density of the output stream.
4. Calculate S_x using the algorithm for determining the parameters a and b of (1). The result is the data set of the following view (pic. 1).



The recovery of the roll spectral density.

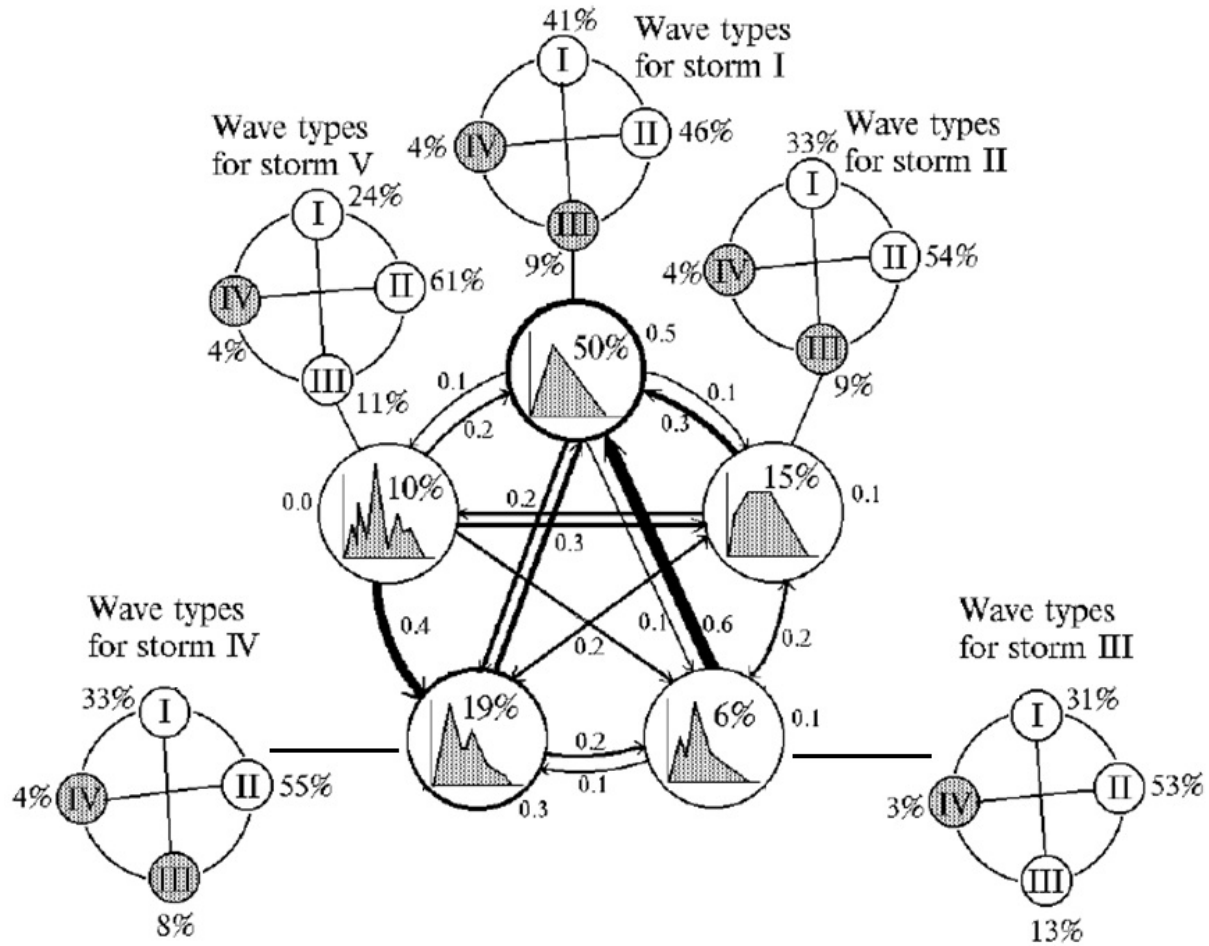


The recovery of the pitch spectral density.

Pic. 1

The solution

5. Find the best solution using the “climatic spectrum” (pic. 2)

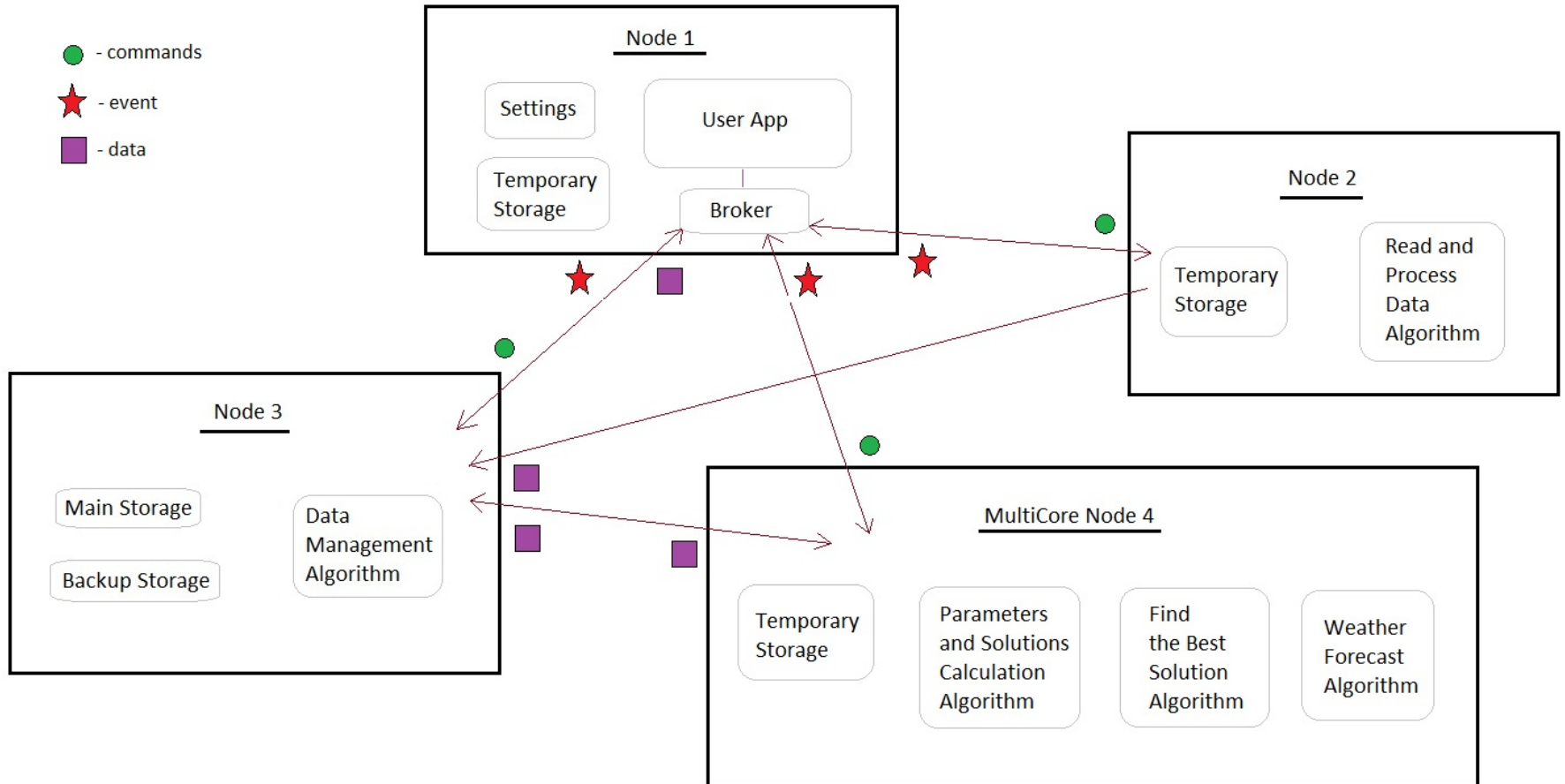


The features of the solution

There are the following features:

1. Read sensor data.
2. Calculate the linearity of the pitch.
3. Calculate parameters of the model and the set of the possible solutions.
4. Find the best solution from the set.
5. Storage and backup storage of all data.
6. Calculation of the forecast and display for the user.
7. The requirement to perform all calculations in real time.
8. Requirement of fault tolerance of one of the nodes.

The software structure



A large, powerful wave is crashing onto a sandy beach. The water is a deep blue-green color, and the foam is bright white. The sky is a clear, pale blue. The wave is the central focus of the image, with its crest breaking over the beach. The text "Вопросы" is overlaid on the wave.

Вопросы