



Success story

Petrobras Designs the P-55 Offshore Platform Using modeFRONTIER

How ESTECO's first Brazilian customer optimized the largest semi-submersible platform in the country

Last year **Petrobras**, a state-owned publicly traded Brazilian multinational energy corporation headquartered in Rio de Janeiro, Brazil, launched their **P-55 offshore platform**, which was initially sized using modeFRONTIER. In order to tackle the complex problem of **multiple variables, constraints and objectives**, as well as a desire for a rational **approach** to the design process, Petrobras turned to **modeFRONTIER** to help them with the optimization study.

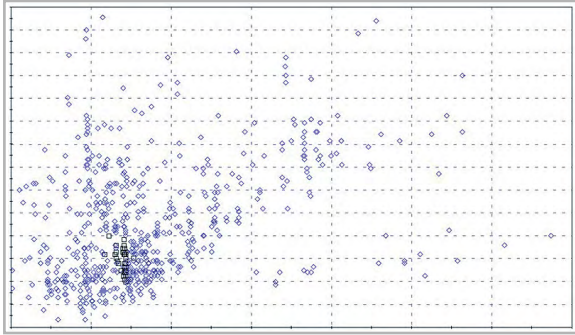
Challenge

Defining the main dimensions of an **offshore production platform** is a complex problem due to the **many variables** that can influence the behavior of the platform, including: deck area, deck weight, subsea systems interface, stability issues and wave-induced motions. The dimensioning process is affected by **many constraints** imposed by more stringent motion requirements, construction and assembly considerations, as well as by the draft limit of shipyards. Ultimately the goal is to **reduce to a minimum the vertical wave-induced motions** which can cause fatigue damage to the **steel catenary risers** (the pipes which bring the oil from the seabed to the platform).

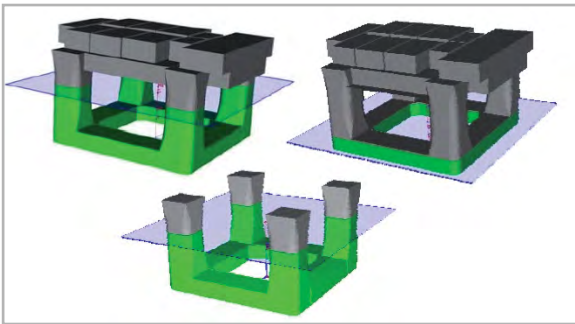
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modeFRONTIER allowed us to rationalize our approach to the problem.

Solution



modeFRONTIER Scatter Chart showing the Designs which met all Constraints (black squares) - Fig.1



Design with the Lowest Vertical Motion of the Riser Connection Area. - Fig.2

Benefits

Dr. Mauro Costa de Oliveira, a naval architect at CENPES, the Petrobras Research Center in Rio, and the first user of modeFRONTIER in Brazil, used the software to integrate the **hydrodynamics analysis tool, WAMIT**, and CENPES's own **stability software, SSTAB**. He then went on to run an optimization study in which **modeFRONTIER** varied 5 key geometric parameters of the platform with the objective of minimizing, subject to numerous constraints, vertical motion of the platform due to wave loading. During the study, the structure was analyzed for **multiple conditions**: quayside, transit and in operation with 2 different wave load conditions. Using one of **modeFRONTIER's genetic algorithms** to drive the search process, Dr Costa de Oliveira was able to identify the **designs which met all the constraints**, and from among those to select the configuration with the lowest riser vertical motion. As can be seen in the scatter chart in Fig. 1, the **feasible region** (ie the part of design space where all constraints were respected) is very small - to identify this region without the help of a tool like modeFRONTIER would have been almost impossible. The final design is shown in Fig. 2.

This work was presented by Dr Costa de Oliveira at the Deep Offshore Technology (DOT) conference in Houston in 2008 in a paper titled "Offshore Platform Sizing Optimization using Genetic Algorithms", which subsequently earned the award for the conference paper using the most innovative technology.

"modeFRONTIER - Dr Costa de Oliveira says - proved to be **invaluable** in helping us to address the **complex problem of selecting the main dimensions** of a deep water floating production system, where there is potentially a **huge number of alternatives** to be evaluated. The software allowed us to **rationalize our approach** to the problem and conduct an automatic search, driven by a genetic algorithm, which **quickly identified the best design** which met all constraints. The **post-processing tools** also proved to be extremely useful for the **conceptual phases** of the design of a deep water floating production system". In **January 2014** the P-55 began operation in **Brazil's Roncador field** at a site where the depth of the seabed is 1,800 meters. At **52,000 tons and 10,000 square meters** in size and displacing **105,000 tons**, the P-55 is the largest semi-submersible platform built in Brazil and one of the largest of its kind in the world; it is capable of processing **180,000 barrels of oil per day**, compressing 6 million cubic meters of natural gas per day, and injecting 290,000 barrels of water per day.

About PETROBRAS

Petrobras is a publicly traded corporation, the majority stockholder of which is the Federal Government (represented by the National Treasury), and performs as an **integrated energy company** in the following sectors: exploration and production, refining, marketing, transportation, petrochemicals, oil product distribution, natural gas, electricity, chemical gas, and biofuels. A leader in the **Brazilian oil industry**, Petrobras has expanded its operations, aiming to be among the top five integrated energy companies in the world by 2030. The company has a presence in 17 countries.

www.petrobras.com



ESTECO is an independent software company, specialized in numerical optimization and simulation process and data management. With a 20-year experience, ESTECO supports over 300 international organizations (such as Ford Motor Company, Honda, Lockheed Martin, Toyota and Whirlpool), accelerating the decision-making process and reducing development time. esteco.com

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