Intelligent Riser Angle Control DPS

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Abstract

DPS (Dynamic Positioning System) is one of the key factors for riser drilling. The importance of the DPS increases as the drill operation progresses to the deeper area. Development/Construction Project of Scientific Ocean Drilling Vessel System for OD21 Program (Ocean Drilling in the 21st century) is now being on design stage in Japan, which will have the capability to drill the 4,000 m water depth sea bottom to MOHO.

Usually, the DP operator decides, keeps, and/or changes the ship position to optimize the riser angles, considering the environmental conditions such as directions/velocities of wind, wave, and current profiles. It becomes more difficult in the deep water drilling for the DP operator to decide DP target position.

This paper proposes a new DPS with automatic riser angle control. This new DPS drives the ship to the optimum position so that the sum of both the squared angles of the riser top and bottom becomes minimal. The control logic is based on neural network, which incorporates riser tension, mud density, top and bottom riser angles, water depth, and current surface velocity as input units. Effects of the dynamic riser deformations on these angles are taken into account in this DPS logic by using modal method. The DPS logic includes estimation of the latest ship position/velocity by using the real time signals of the riser top and bottom angles. That means the system does not need conventional position reference systems such as GPS (Global Position System), HPR (Hydro-acoustic Position Reference System), etc. Research results showed that it could estimate and control the ship position by these angles.

Two dimensional (2D) and 3D model basin experiments were performed using a ship model with a riser model under various current conditions. This paper focuses on 3D model test carried out in January 2000. The results of computer simulation corresponded well with the model basin experiments. Thus, the developed logic was confirmed to be feasible as the new DPS and the simulation method was found to be valid.

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