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# A Methodology for Determining Offshore Floating Facilities Kinematics from Accelerometers and GPS Field Measurements

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## Abstract

Permanent floating offshore facilities can be subjected to substantial environmental loads in the Gulf of Mexico, especially during the hurricane season. This paper focuses on the procedures required for the accurate computation of the floating system kinematics based on the output of installed measuring devices and on important issues in processing of the recorded data.

Measurement of floater kinematics is based on accelerometers, angular rate sensors, and the Differential Global Positioning System (DGPS). Careful understanding of the characteristics of each instrument is essential to integrity management, as well as to research programs based on field data. Moreover, understanding the unique dynamic and geometric characteristics of the floating facility is also vital in the computation of its motions.

This paper examines the motion measurement package installed on the Holstein Spar Platform, and highlights the various steps involved in deriving motions of the Spar using the data recorded during Hurricane Rita and Katrina. The paper illustrates the general mathematical and numerical procedures, involved in the post processing. The data from hurricanes are used to demonstrate the challenges involved in proper interpretation of field measurements.

The possible pitfalls in the conversion of the raw measured data to motion quantities of interest are highlighted. The analysis presented in the paper involves steps that are required to correctly interpret the measurement, and would be applicable to any type of offshore floating facility. Other considerations that are unique to Spar platforms are also discussed. The results presented in this paper will help in better understanding of the field data and would lead to better practices in the integrity management of offshore platforms.

## Introduction

The broad integrity management program that BP has implemented in the Gulf of Mexico includes continuous monitoring of the company's deepwater floating facilities through a permanently installed Integrated Marine Monitoring System (IMMS) [1] among other deployed monitoring systems [2]. The IMMS, installed on all seven deepwater floating facilities operated by BP, receives and records a number of channels from mounted monitoring instrumentation that measures the hull, risers and mooring lines behavior as well as the current and wind speed among other environmental parameters.

The Holstein truss spar is located in the Green Canyon field Block 645 and one of the biggest spar platforms build to date. During the intense hurricane season of 2005, the IMMS on board Holstein, recorded extreme levels of environmental excitation as well as substantial values of spar motion response compared to other storms. These valuable field measurements enabled the verification of design values of several parameters that were used for the design of the platform [3]. This paper focuses on the methodology used to derive the spar kinematics from measurement records of the IMMS accelerometers, angular rate sensors, and Differential Global Positioning System (DGPS).