Co-simulation of multibody system dynamics and moving particle semi-implicit method for heavy load lifting operations in shipyards

Sol Ha
Research Institute of Marine Systems Engineering, Seoul National University
Seoul, Korea

Ki-Su Kim, Seung-Ho Ham
Department of Naval Architecture and Ocean Engineering, Seoul National University
Seoul, Korea

Myung-Il Roh
Department of Naval Architecture and Ocean Engineering, and Research Institute of Marine Systems Engineering, Seoul National University
Seoul, Korea

Namkug Ku
Department of Naval Architecture and Ocean Engineering, Dong-eui University
Busan, Korea

ABSTRACT

Since various existing simulation tools based on multibody system dynamics (MSD) focus on conventional mechanical systems, such as machinery, car, and spacecraft, there are some problems with the application of such simulation tools to shipbuilding domains due to the absence of specific items in the field of naval architecture and ocean engineering, such as hydrostatics and hydrodynamics. Thus, in this paper, we describe how to simulate heavy load lifting operations in shipyards by using multibody system dynamics and moving particle semi-implicit (MPS) method. The crane systems in shipyards are all multibody systems which the multiple rigid bodies are jointed together, so the multibody system dynamic was used to analyze its dynamic response. The moving particle semi-implicit method was applied to compute nonlinear motions of a floating vessel. Co-simulation with these two method was applied to actual operations in shipyards.

KEY WORDS: Multibody system dynamics; moving particle semi-implicit (MPS) method; operations in shipyards.

INTRODUCTION

Background

Requests for accurate dynamic analysis using a simulation tool have been increasing in many engineering fields, including in the shipbuilding industry. Unlike the conventional mechanical systems such as cars and machinery, all ships and offshore structures differ in purpose, shape, and size. Fig. 1 shows various examples of operations in offshore plants domain. Even though operation planning may be set up based on the experience of similar ships and offshore structures, many unexpected problems may occur during their production. For example, an interference between a block and the wire ropes, the de-synchronization between the cranes, the excess of the maximum tension of the wire ropes, etc. can occur during the production of ships and offshore plants. Moreover, due to the recent increase in the demand for offshore plants and new-concept ships, new manufacturing methods in shipyards are frequently reviewed with simulation, including with dynamic analysis, to confirm their availability and safety.

Fig. 1. Overview of heavy load lifting operations in offshore plants domain.