

## **A PROTOTYPE FOR SIMULATING THE KINEMATICS OF CRANE RIGGING OSCILLATORY MOTION USING SIMPHONY.NET**

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### **ABSTRACT**

Crane hoisting operations represent a significant portion of the work scope on construction sites, especially those that have adopted a modularized approach to construction. Creating metrics that can be used in the automation of these processes can result in higher jobsite efficiencies from a safety and productivity perspective. This study created a virtual simulation environment prototype that can be experimented with to generate the required metrics for crane hoisting automation. The equation of motion for this oscillatory motion was first defined. Thereafter numeric solutions to this equation were explored from a continuous simulation perspective using Symphony.NET. Then prototyping of simple pendulum motion was implemented using the continuous simulation services in Symphony.NET and verification done using Mathematica.

### **1 INTRODUCTION**

The construction industry's core business entails the production of infrastructure/facilities or components that are used in the erection of infrastructure/facilities. Just like any other production system, one of the major concerns of construction is the handling of various materials, most of which are bulky. Effective material handling requires logistics that facilitate their material manufacture, transportation/distribution, storage/warehousing, and disposal. Examples of such logistics include: manual, semi-automated, and automated equipment. There is a wide range of machines that fall in these categories, these include: conveyors, hoisting equipment, industrial robots, pallet jacks, lift trucks, etc.

There have been a number of trends in material handling that have been started with the sole purpose of improving the efficiency with which material handling is done. The first of these trends was started by Fredrick Taylor who is also regarded as the founding father of the industrial engineering domain (Robinson 2015). Taylor did most of his work in the area of improving manual loading processes and his work led to subsequent efforts that resulted in mechanization of the material handling process and later the automation of the machines used. The study presented in this paper seeks to follow this trend and further efforts that strive to achieve higher efficiencies in material handling. The focus is restricted to hoisting equipment, specifically cranes, because they are the most predominant type of equipment utilized in construction. For example, cranes are used for handling and lifting precast concrete sections, steel pieces, vessels, equipment, modules, etc., within construction sites. There are a number of issues that exist in rigging operations. The one being dealt with in this study is presented in the section that follows.























