Lecture Notes in Electrical Engineering 978

Anu Gokhale
Emanuel Grant *Editors*

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Preface

It is our pleasure to introduce you to the Proceedings of the 2021 Asia Pacific Computer Systems Conference (APCS 2021) which was held virtually to minimize the risk of COVID-19. The safety and well-being of all participants are our top priority. At the same time, we strive to provide this long-awaited conference for many scholars and researchers to conduct academic exchanges with colleagues.

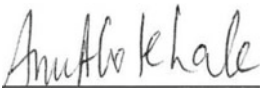
APCS 2021 provides a scientific platform for both local and international scientists, engineers and technologists who work in all aspects of Computer Systems. In addition to the contributed papers, internationally known experts from several countries are also invited to deliver keynote and invited speeches at APCS 2021.

The volume includes 14 selected papers which were submitted to the conference from universities, research institutes and industries. Each contributed paper has been peer-reviewed by reviewers who were program committee and technical committee members as well as other experts in the field from different countries. The proceedings are intended to present to the readers the newest research results and findings in the field of Computer Systems.

Much of the credit of the success of the conference is due to topic coordinators who have devoted their expertise and experience in promoting the conference as well as general co-ordination, organization and operation of the activities during the conference. The coordinators of various session topics devoted considerable time and energy in soliciting papers from relevant researchers for presentation at the conference.

The chairpersons of the different sessions played important role in conducting the proceedings of the session in a timely and efficient manner and on behalf of the conference committee, we express sincere appreciation for their involvement. The reviewers of the manuscripts, those by tradition would remain anonymous, have also been very helpful in efficiently reviewing the manuscripts, providing valuable comments well within the time allotted to them. We express our sincere gratitude to all reviewers.

We strongly believe that APCS 2021 will channelize intellectual resources relevant to Computer Systems and provide a roadmap for further studies, investigations, analyses, and applications in this field.



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About the Editors

Dr. Anu Gokhale is professor and department chairperson at St. Augustine's University, USA. She has completed thirty years as Faculty and has received several college and university research, teaching, and service awards. Dr. Gokhale was named Fulbright Distinguished Chair in STEM+C at the University of Pernambuco, Brazil, 2016–17; was Faculty Fellow in Israel and Fulbright Specialist in Cybersecurity at Gujarat Technological University, India, in 2017; and was Visiting Professor in College of Business at Shandong University, China, in 2017 where she focused on data analytics and e-commerce. Her achievements encompass extensively cited refereed publications, groundbreaking externally funded research supported by a continuous stream for 20 years of grants from state and federal agencies including the National Science Foundation, and elevation of the ISU student experience through excellence in teaching, mentorship, and the creation of opportunities for students to get involved in research. She consults for business and industry to increase productivity using data analytics and leveraging etechnologies. She has delivered multiple workshops focusing on inclusion and diversity as well as "STEM for All" public policy.

Dr. Emanuel Grant received his B.Sc. from the University of the West Indies, MCS from Florida Atlantic University, and Ph.D. from Colorado State University, all in Computer Science. Since 2008, he is Associate Professor in the Department of Computer Science and the School of Electrical Engineering and Computer Science at the University of North Dakota, USA, where he started as Assistant Professor in 2002. He currently serves as Associate Director of the School of Electrical Engineering and Computer Science. His research interests are in software development methodologies, formal specification techniques, domain-specific modeling languages, model-driven software development, and software engineering education. Dr. Grant has conducted research in software engineering teaching with collaborators from Holy Angel University, Philippines; HELP University College, Malaysia; III-Hyderabad, India; Singapore Management University, Singapore; Montclair State University,

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Computer and Automation Systems

Optimal Design of Rail Support Structure for Mountain Rail Transport Vehicle

Zhu Chen, Tao Lin, Hong Chen, Bingfeng Bai, and Guohong Zhang

Abstract The rail transport vehicle is a solution for the transportation of heavy materials in mountainous areas. The support scheme of the rail is the key and difficult point of the design, but unified design criterion has not been established in many industries. In order to meet the requirements of the technical development of rail transport vehicles and improve the reliability of rail transport, the rail support structure needs to be optimized. This paper uses ANSYS Workbench 19.0 to analyze the strength of the rail support structure of the dual rail transport vehicle, compares the stress conditions of the three support structures, and optimizes the design of installation height of the support to ensure the safety and reliability of the support structure in practical applications. The final analysis results show that the stress of the cross-braced structure scheme is optimal, and within the range allowed by the structural design, the height of the connection point of the diagonal bracing can be increased as much as possible to increase the structural stability.

Keywords Rail transport vehicle · Support structure · Optimal design · Finite element analysis

1 Introduction

The rail transportation system is a new transportation method in which the truck is towed and transported by the engine equipped with the locomotive and rides on a specific rail. At present, the mainstream rail transportation methods include monorail

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transportation and dual rail transportation. Monorail transportation technology has been developed very maturely, and it has been used in many countries and regions for many years. At present, it has been used in agricultural production activities such as mountain fruit picking and fertilization and, to a certain extent, has improved the mechanization level of agricultural transportation. However, the maximum load of the monorail transport vehicle does not exceed 1 ton, which is difficult to meet the application in mining, metallurgy, and construction projects. The maximum load of the dual rail transport vehicle can reach 4 tons, and it has strong overturning resistance, which can meet the transportation needs of materials below 4 tons in mining, metallurgy, and engineering construction in mountainous areas. It can be predicted that with the development of rail transportation technology, the rail transportation system will be widely used in more industries in the future, and a set of standard system will be established.

The monorail transportation system is only suitable for small loads. Its overturning resistance as a monorail is weak, as shown in Fig. 1. Although the dual rail transportation system has the ability to transport large loads, its rails are often laid close to the ground, and the transport vehicles also run close to the ground, which cannot be applicable for the complex and variable terrain in mountainous areas, as shown in Fig. 2. Therefore, it is necessary to study the overhead rail of the dual rail transportation system. Compared with the monorail transportation system, the structure of the dual rail transportation system, especially the rail support structure, is more complicated. At present, no systematic reference exists in the actual design process, which lead to our inability to judge which support structure can achieve the best, and inability to confirm the weak position of rail support structure where the potential safety hazards exist. This paper will conduct finite element analysis and discuss the stress conditions of three support structures under the same boundary conditions by means of the ANSYS Workbench 19.0 tool: (1) Set up diagonal support column to assist in supporting vertical columns; (2) connect the vertical support columns at the same position on both sides of the rail with beam to form a truss; and (3) connect the vertical support columns at the same position on both sides of the rail with two diagonal braces to inability to form a cross-braced structure. Finally, the optimal structure is selected, the support height and material strength are changed, and the stress improvement condition is further discussed.

2 Finite Element Theory

The transport vehicle runs smoothly and slowly on the rail, and the deformation of the rail and support structure can be regarded as the elastic deformation under the static load, which conforms to the small deformation assumption in the mechanics of materials [1–3]. Therefore, the problem studied in this paper belongs to the category of elastic mechanics. Starting from the micro-unit, considering the three aspects of static force, geometry, and physics, the basic differential equations are obtained for solution, and finally the constants in the solution are determined by using the