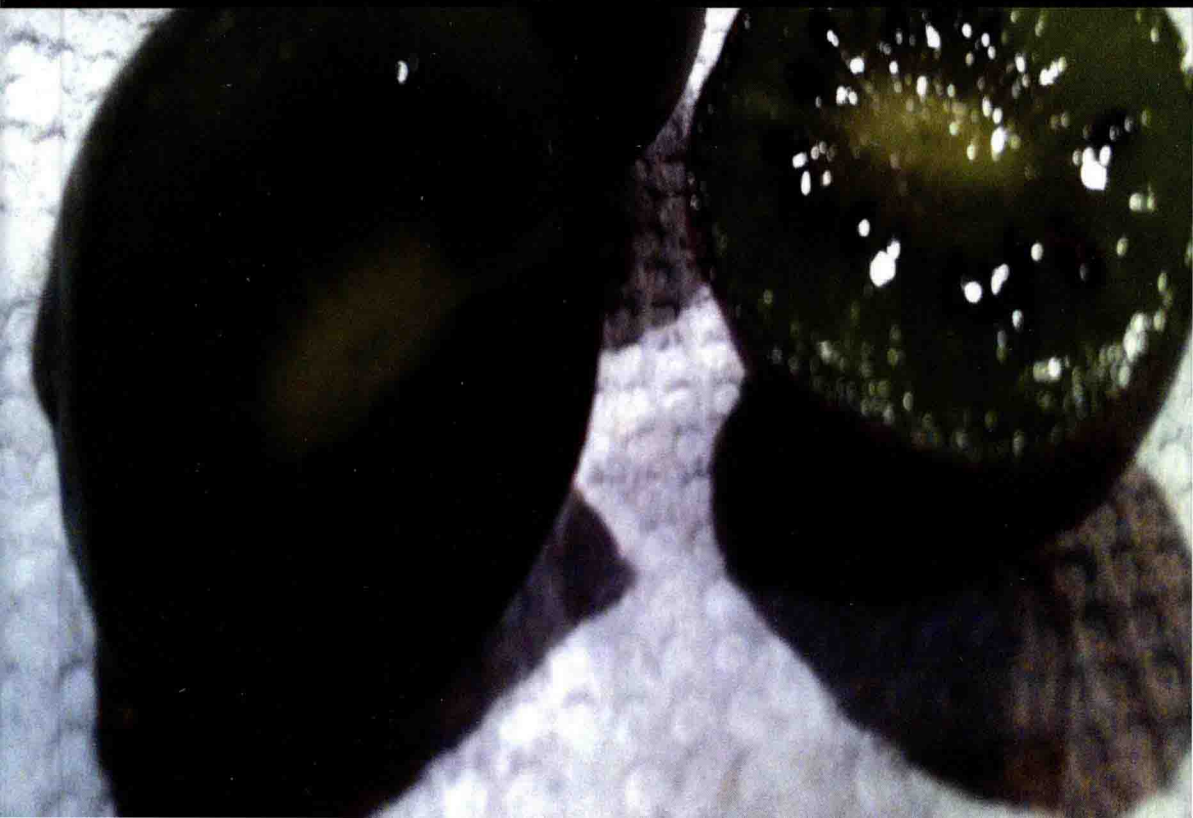


Fuzzy Randomness: Uncertainty in Civil Engineering

Contributors

Yuanlong Yang, Fangmeng Zheng, et al.

Edited and Compiled by Auris Reference Editorial Board



Fuzzy Randomness: Uncertainty in Civil Engineering

Contributors

Yuanlong Yang, Fangmeng Zheng et al.



www.aurisreference.com

Fuzzy Randomness: Uncertainty in Civil Engineering

Contributors: Yuanlong Yang, Fangmeng Zheng et al.

Published by Auris Reference Limited

www.aurisreference.com

United Kingdom

Copyright 2015 -- Edition 2016

The information in this book has been obtained from highly regarded resources. The copyrights for individual articles remain with the authors, as indicated. All chapters are distributed under the terms of the Creative Commons Attribution License, which permit unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Notice

Contributors, whose names have been given on the book cover, are not associated with the Publisher. The editors and the Publisher have attempted to trace the copyright holders of all material reproduced in this publication and apologise to copyright holders if permission has not been obtained. If any copyright holder has not been acknowledged, please write to us so we may rectify.

Reasonable efforts have been made to publish reliable data. The views articulated in the chapters are those of the individual contributors, and not necessarily those of the editors or the Publisher. Editors and/or the Publisher are not responsible for the accuracy of the information in the published chapters or consequences from their use. The Publisher accepts no responsibility for any damage or grievance to individual(s) or property arising out of the use of any material(s), instruction(s), methods or thoughts in the book.

Fuzzy Randomness: Uncertainty in Civil Engineering

ISBN: 978-1-78154-591-1

British Library Cataloguing in Publication Data

A CIP record for this book is available from the British Library

Printed in the United Kingdom

Fuzzy Randomness: Uncertainty in Civil Engineering

List of Contributors

Jingshu Zhang

School of Civil Engineering and Mechanics, Lanzhou University, Lanzhou, China

Yuanlong Yang

School of Civil Engineering and Mechanics, Lanzhou University, Lanzhou, China

Fangmeng Zheng

School of Civil Engineering and Mechanics, Lanzhou University, Lanzhou, China

Tuan D. Pham

Aizu Research Cluster for Medical Engineering and Informatics, Center for Advanced Information Science and Technology, the University of Aizu, Aizu-Wakamatsu, Fukushima, Japan

Krystyna Mazur-Uniady

Wroclaw University of Technology, Institute of Civil Engineering, Wybrzeze Wyspia ̇nskiego 27, 50-370 Wroclaw, Poland

Katarzyna Misiurek

Wroclaw University of Technology, Institute of Civil Engineering, Wybrzeze Wyspia ̇nskiego 27, 50-370 Wroclaw, Poland

Olga Szybko-Bigus

Wroclaw University of Technology, Institute of Civil Engineering, Wybrzeze Wyspia ̇nskiego 27, 50-370 Wroclaw, Poland

Paweł Uniady

Wroclaw University of Environmental and Life Science, The Faculty of Environmental Engineering and Geodesy, Plac Grunwaldzki 24, 50-365 Wroclaw, Poland

Kasim A Korkmaz

Civil Engineering Department, Suleyman Demirel University, Isparta
32260, Turkey

Fuat Demir

Civil Engineering Department, Suleyman Demirel University, Isparta
32260, Turkey

Hamide Tekeli

Civil Engineering Department, Suleyman Demirel University, Isparta
32260, Turkey

Giuseppe Carlo Marano

Dipartimento di Ingegneria dell'Ambiente e per lo Sviluppo Sostenibile
(DIASS), Politecnico di Bari, Viale del Turismo 8, 74100 Taranto, Italy

Emiliano Morrone

Dipartimento di Ingegneria dell'Ambiente e per lo Sviluppo Sostenibile
(DIASS), Politecnico di Bari, Viale del Turismo 8, 74100 Taranto, Italy

Giuseppe Quaranta

Dipartimento di Ingegneria dell'Ambiente e per lo Sviluppo Sostenibile
(DIASS), Politecnico di Bari, Viale del Turismo 8, 74100 Taranto, Italy

Francesco Trentadue

Dipartimento di Ingegneria dell'Ambiente e per lo Sviluppo Sostenibile
(DIASS), Politecnico di Bari, Viale del Turismo 8, 74100 Taranto, Italy

Shih-Tong Lu

Graduate Institute of Project Management, Kainan University, No. 1 Kainan Road, Luchu, Taoyuan 33857, Taiwan

Department of Business Administration, National Central University, No. 300 Jhongda Road, Jhongli, Taoyuan 32001, Taiwan

Shih-Heng Yu

Department of Business Administration, National Central University, No. 300 Jhongda Road, Jhongli, Taoyuan 32001, Taiwan

Dong-Shang Chang

Department of Business Administration, National Central University, No. 300 Jhongda Road, Jhongli, Taoyuan 32001, Taiwan

Maria Valeria Piras

Department of Civil Engineering, Environmental Engineering and Architecture (DICAAR), University of Cagliari, Via Marengo 2, 09123 Cagliari, Italy

Fausto Mistretta

Department of Civil Engineering, Environmental Engineering and Architecture (DICAAR), University of Cagliari, Via Marengo 2, 09123 Cagliari, Italy

Maria Luisa Fadda

Department of Civil Engineering, Environmental Engineering and Architecture (DICAAR), University of Cagliari, Via Marengo 2, 09123 Cagliari, Italy

Luisa Deias

Department of Electrical and Electronic Engineering (DIEE), University of Cagliari, Via Marengo 2, 09123 Cagliari, Italy

Tsu-Ming Yeh

Department of Industrial Engineering and Management, Da-Yeh University, Changhua, Taiwan

Fan-Yun Pai

Department of Business Administration, National Changhua University of Education, Changhua, Taiwan

Chi-Wen Huang

Department of Industrial Engineering and Management, Da-Yeh University, Changhua, Taiwan

Department of Business Administration, National Changhua University of Education, Changhua, Taiwan

Nataša Glišović

Department of Mathematical sciences, State University of Novi Pazar, Vuka Karadžića bb, 36300 Novi Pazar, Serbia

Lu Gan

Urban and Rural Development College, Sichuan Agricultural University, Dujiangyan 611830, China

Uncertainty Decision-Making Laboratory, Sichuan University, Chengdu 610064, China

Jiuping Xu

Uncertainty Decision-Making Laboratory, Sichuan University, Chengdu 610064, China

State Key laboratory of Hydraulics and Mountain River Engineering, Sichuan University, Chengdu 610064, China

Preface

The text *Fuzzy Randomness: Uncertainty in Civil Engineering* deals with a new and important subject of mathematical modeling in engineering that is uncertainty models in civil engineering. It deals with fuzzy functions and fuzzy random functions. The application of fuzzy randomness is demonstrated in three fields of civil engineering and computational mechanics: structural analysis, safety assessment, and design. First chapter focuses on the professional qualities and cultivation of civil engineering students, which are also problems in civil engineering teaching. Second chapter presents an integrated approach for estimating the spatial uncertainty of vagueness in images using the theory of geostatistics and the calculus of probability measures of fuzzy events. The aim of third chapter is to find the solution for the membership function of the probabilistic characteristics of the response of the structure. In fourth chapter, a new approach has been proposed to investigate the effects of material uncertainty of concrete on calculating critical buckling loads of reinforced concrete column members. In fifth chapter, a new methodology has been introduced to analyze the response of a TMD subject to a nonstationary filtered white noise using a hybrid approach based on the fuzzy and stochastic theories. Sixth chapter investigates the risk factors in railway reconstruction project through complete literature reviews on construction project risks and scrutinizing experiences and challenges of railway reconstructions in Taiwan. A reliable visual inspection method for vulnerability assessment of hyperstatic structures using fuzzy logic analysis has been presented in seventh chapter. Eighth chapter proposes a new method to calculate %GR&R and then compare the %GR&R calculated according to the methods in MSA manual and that calculated from the proposed method. In ninth chapter, we discuss the fuzzification of a linear programming model to deal with project crashing problems in uncertain environments, where we have imprecision in the constraints boundaries and also in the objective function. Last chapter focuses on the problem of hedging against seismic risk through the retrofit of transportation systems in large-scale construction projects (LSCP).

Contents

	<i>List of Contributors</i>	<i>vii</i>
	<i>Preface</i>	<i>xi</i>
Chapter 1	Qualities Required for Civil Engineering Students from a Project Accident.....	1
	Yuanlong Yang, Fangmeng Zheng, Jingshu Zhang	
Chapter 2	Spatial Uncertainty Modeling of Fuzzy Information in Images for Pattern Classification	13
	Tuan D. Pham	
Chapter 3	Fuzzy Stochastic Vibrations of Double-Beam Complex System as Model Sandwich Beam with Uncertain Parameters	39
	Krystyna Mazur-Uniady, Katarzyna Misiurek, Olga Szybko-Bigus, and Paweł Uniady	
Chapter 4	Uncertainty Modelling of Critical Column Buckling for Reinforced Concrete Buildings.....	67
	Kasim A Korkmaz, Fuat Demir, and Hamide Tekeli	
Chapter 5	Fuzzy Structural Analysis of a Tuned Mass Damper Subject to Random Vibration	87
	Giuseppe Carlo Marano, Emiliano Morrone, Giuseppe Quaranta, and Francesco Trentadue	
Chapter 6	Using Fuzzy Multiple Criteria Decision-Making Approach for Assessing the Risk of Railway Reconstruction Project in Taiwan.....	111
	Shih-Tong Lu, Shih-Heng Yu, and Dong-Shang Chang	
Chapter 7	A Reliable Visual Inspection Method For Vulnerability Assessment of Hyperstatic Structures Using Fuzzy Logic Analysis .	137
	Maria Valeria Piras, Fausto Mistretta, Maria Luisa Fadda, and Luisa Deias	

Chapter 8	Using Fuzzy Theory in %Gr&R and NDC of Measurement System Analysis.....	177
	Tsu-Ming Yeh, Fan-Yun Pai, and Chi-Wen Huang	
Chapter 9	Comparison of A Fuzzy Genetic and Simulated Annealing Algorithm Approach for Project Time-Cost Tradeoff	207
	Nataša Glišović	
Chapter 10	Retrofitting Transportation Network Using a Fuzzy Random Multiobjective Bilevel Model To Hedge Against Seismic Risk	235
	Lu Gan and Jiuping Xu	
	Citations	291
	Index	295

Chapter 1

QUALITIES REQUIRED FOR CIVIL ENGINEERING STUDENTS FROM A PROJECT ACCIDENT

Jingshu Zhang, Yuanlong Yang, Fangmeng Zheng

School of Civil Engineering and Mechanics, Lanzhou University, Lanzhou, China

ABSTRACT

Civil engineering educational circles have always been focusing on the professional qualities and cultivation of civil engineering students, which are also problems in civil engineering teaching. In the beginning of professional course teaching, the author introduced an real project accident and specially emphasized that responsibility, teamwork, seriousness, carefulness, comprehensively applying of knowledge, working in accordance with codes are considered as quality requirements of civil engineering students. This teaching thought is carried out through the whole teaching process, which brings deep impression to students and good teaching effect. The teaching thought is introduced in this paper.

INTRODUCTION

The basic task of engineering education in colleges and universities [1] is to make students accept systematic theoretical knowledge

of science and engineering, practice and learn basic skills and be equipped with essential qualities that an engineer should have when they graduate from school. Civil engineering specialty training goal in Lanzhou University[2] is cultivating innovative talents which possesses strong mechanic and engineering theory foundation, have the ability to participate in civil engineering project of scientific research, planning, design, construction and management, suffice to be engaged in research, technology or management work in department of research, design and management in the field of building construction, underground engineering, roads and bridges and be capable of strong ability in engineering practice and preliminary scientific research. Lanzhou university civil engineering specialty offers courses of "masonry structure" in the second semester of the third year and it's also the first professional course. At this time, students' study time in school has passed more than half, and they have mainly completed the foundation courses like mathematics and mechanics, and achieve a status change from students to engineers which they will obtain in practical work. Therefore, the aim of professional teaching is not only to impart knowledge, more important is to cultivate student's quality and enhance work ability. Hence, how to raises the students' quality is a problem that must be paid close attention by civil engineering professional teachers. The author has undertaken teaching work of "masonry structure" course since 2004. In the first class, by an engineering accident as background, the quality civil engineering students should have and the problems caused by a lack of professional quality was introduced. And this will be a reference for engineering teaching fellows.

ENGINEERING ACCIDENT SITUATION

General Situation

August 13, 2007, the dixi tuojiang bridge which was underconstruction in fenghuang county, Hunan province, produced special major collapse, 64 people killed and 4 seriously injured, causing a direct economic loss of 39.747 million Yuan[3].

The dixi tuojiang bridge started in March 12, 2004, and the planned working period was 16 months. The bridge, which connected fenghuang county in Hunan province and tongren daxing airport in

Guizhou province, is one of the important controlling engineering of the fengda Highway projects. The bridge, a kind of multiple-arch stone one, is 328.45 meters length, 13 meters width of bridge deck, 33 meters high of bridge pier, and the bridge type is a 65 meters span with four holes, uniform section, catenaries, hollow and no hinge arch bridge.

When the accident happens, the masonry of abdomen arch ring, side wall and the stuffing on arch has basically completed, the work of dismantling scaffold was near the end. The bridge was planned to be completed in the end of August, and be open to traffic in September 20, 2007, which would be a tribute for xiangxi autonomous prefecture celebration of 50 years.

The bridge constructional enterprise is xiangxi autonomous prefecture fengda highway construction Co., LTD. (referred to as Fengda Company), belongs to the people's government of xiangxi autonomous prefecture, and is a wholly state-owned company. The design and geological exploration unit is Huagang design institute, ownership by the whole people, belongs to Changsha University of Science and Technology, and has class A project design certificate and engineering survey certificate in Highway industry. The construction unit is Hunan Road & Bridge Construction Group Company (referred to as Road & Bridge Company), a wholly state-owned large-scale enterprise, has qualification certificates like highway engineering construction general contracting super certificate. A level 2 institution of Road & Bridge Company, the seventh road company takes charge of the specific construction tasks of the dixi tuojiang bridge. The construction supervising unit is Hunan jinqu traffic consultation and supervision Co., LTD has a class A qualification of highway engineering supervision.

Accident Cause

- immediate cause of the accident

The construction material of bridge main arch ring can't meet with the requirements of design and standard specification; Construction process of the upper structure of arch bridge is not reasonable; and construction quality of main arch ring is poor, which reduces the integrity and strength of arch ring masonry. With the load on the arch increasing, 3 to 4 meters wide range of the main arch ring, close to abutment zero, and which belongs to No.1 bridge opening, scilicet, the fee of No.2 abdominal arch became invalidated, as masonry

strength reached their limit of failure. Affected with multiple arch actions, the whole bridge collapsed quickly.

- The primary reason of the accident

First of all, the construction unit changed the arch ring construction plan without authorization. The mismanaged construction site and illegal use of construction materials gave rise to the result that the construction of main arch ring do not meet building code requirements, and the main arch ring did not reach the design strength before the scaffold was dismantled.

Second, the project management of the bridge constructional enterprise was in disorder, and it failed to seriously supervise and urge construction unit to put them right when the construction quality problems were discovered. The bridge constructional enterprise lined up with the construction unit altered the construction plan of main arch ring without authorization. Furthermore, the bridge constructional enterprise blindly adopted inverted arrangement for the sake of driving time limit for the project, and was in command of construction beyond its authority, even if asking supervisor not to inspect on the bridge.

Third, the construction supervising units failed to stop the construction unit to alter construction plan of the main arch ring, and cannot effectively supervise and urge construction unit to correct quality problem of main arch ring. When the main arch ring laying completed, it signed acceptance of the project before strength material detected.

Fourth, the design and geological investigation unit illegally subcontract exploration projects to individual, which generated that the design depth of geological survey was not enough, and that the field service and technical interpretation of design intention is poor.

Fifth, the traffic quality control department severely neglected its duty of project quality supervision.

Sixth, two different level of government, xiangxi autonomous prefecture and Fenghuang County, coupled with relevant departments of Hunan province failed to effectively exercise supervision in project approval, bidding, quality and safety production. Autonomous prefecture government asked to drive time limit of the project in order to tribute to xiangxi autonomous prefecture celebration of 50 years.