

Mechanisms and Machine Science

Volume 11

Series Editor

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Vibration of Hydraulic Machinery

 Springer

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ISSN 2211-0984

ISBN 978-94-007-6421-7

DOI 10.1007/978-94-007-6422-4

Springer Dordrecht Heidelberg New York London

ISSN 2211-0992 (electronic)

ISBN 978-94-007-6422-4 (eBook)

Library of Congress Control Number: 2013932129

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Foreword

It is a privilege to be asked to write a prefatory note for this monograph reflecting the latest advance in the field of vibration of hydraulic machinery. Working on this book with Prof. Yulin Wu, a good friend and colleague for decades, and his outstanding team members was an enjoyable experience.

A jointly authored book like this has a root back to the last century. It began in the early 1980s when for the first time I heard about Yulin, a fast-rising scholar from Prof. Zuyan Mei. Indeed in the late 1960s, with Prof. Mei and scholars from the Beijing Institute of Hydropower, a monograph *Transient Process of Hydraulic Turbine* (in Chinese) initiated by me was written but cancelled for publication in 1969. Nevertheless, it inspired the *Book Series on Hydraulic Machinery* in 1986. Yulin and Prof. Mei were actively participating in the writing of this book series meanwhile they extended their work into the new field of numerical simulations for turbines including pump-storage turbines. After Prof. Mei deceased in 2003, Prof. Wu continues leading and developing this team at Tsinghua, producing remarkable numerical works. The excellence of their work on vibration simulations made him an ideal candidate for writing a continuous volume of the title *Vibration and Oscillation of Hydraulic Machinery* published two decades ago, emphasizing on numerical predictions. Being thus invited, he discussed the scope and set up the framework with me in late 2003. Then he started preparing the manuscripts together with Prof. Shuhong Liu who joined later. During the summer of 2008, while Yulin and Shuhong visiting me at Warwick, the first draft manuscript was proposed by Yulin with my contributions mainly to [Chaps. 1, 6 and 7](#). Later on Profs. Zhongdong Qian and Hua-Shu Dou, both former team members of Yulin at Tsinghua, joined in 2011 and 2012 respectively.

Now I am pleased to witness the completion of this book reflecting such a collective willingness and effort across decades.

Personally, I would like to thank all the supports received to my research programmes and involvement in this book. These are the UK ESRC/EPSRC grants, the 10-year support from the UK EPSRC WIMRC grants and the generous support from the UK Royal Academy of Engineering; and the Open Fund of Tsinghua University (State Key Laboratory of Hydrosience and Engineering) and the financial and technical support from the Three Gorges authority.

In particular, it is a great honour to receive the award of Chinese Global Recruit Programme of Peking University that enables me to work in Beijing closely with authors during the final stage of the book writing. The support from Prof. Cunbiao Lee of Peking University is thus highly appreciated.

20 October 2012

Shengcai Li
Zhong-guan Xin-yuan
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Preface

The present book *Vibration of Hydraulic Machinery* deals with the vibration problem which has significant influence on the safety and reliable operation of hydraulic machinery. It provides with the new achievements and the latest development in these areas in the community including those by the authors, even in the basic areas of this subject.

The prediction for vibration of hydraulic machinery is currently an important subject since vibration has a major effect on the performance of hydraulic machinery. In the last 10 years, progress has been achieved in theory, modeling, and mathematical analysis, as well as monitoring of vibration of hydraulic machinery. With hydraulic turbine capacities getting increasingly larger and pump speeds ever higher, there have been many research achievements in these areas published in symposiums, journals, and books.

This book covers the fundamentals of mechanical vibration and rotordynamics as well as their main numerical models and analysis methods for the vibration prediction. The mechanical and hydraulic excitations to the vibration are analyzed, and the pressure fluctuation induced by the unsteady turbulent flow is predicted in order to obtain the unsteady loads. This book also discusses the loads, constraint conditions, and the elastic and damping characters of the mechanical system, the structure dynamic analysis, the rotor dynamic analysis, and the instability of system of hydraulic machines, including the illustration of monitoring system for the instability, and the vibration in hydraulic units. Solutions of all the problems are necessary for vibration prediction of hydraulic machinery.

The authors of the present book are as follows: **Chap. 1:** Shengcai Li, **Chap. 2:** Shuhong Liu, **Chap. 3:** Zhongdong Qian, **Chap. 4:** Leqing Wang and Dazhuan Wu, **Chap. 5:** Shuhong Liu, **Chap. 6:** Shengcai Li, **Chap. 7:** Shengcai Li, **Chap. 8:** Dazhuan Wu and Yulin Wu, **Chap. 9:** Zhongdong Qian, **Chap. 10:** Hua-Shu Dou, and **Chap. 11:** Lei Jiao and Yulin Wu. Professor Hua-Shu Dou made final reviewing and compiling of the whole contents of the book.

The authors would like to thank the National Natural Science Foundation of China (NSFC) for main key project grants (contracts No. 59493700) on the key technology of hydraulic turbine generator unit of three gorges projects (1994–1999), and for key project grants (contracts No. 90410019, 2004–2007 and 10532010, 2006–2009), as well as other five projects, i. e., China Yangtze Three

Gorges Project Development Cooperation (CTGPC) for project grants (contracts No. CT-02-04-04 and CT-03-04-01); China Longtan Hydropower Development Company Ltd. for project grants (2001–2002); Harbin Institute of Large Electric Machinery & Hydraulic Turbine for project grants (contracts No. 2002158 and 2006429).

Many thanks to Fujian Electric Power Test & Research Institute, Beijing Huake Tongan Monitoring Technology Co. Ltd., Tianjin Tianfa Heavy Machinery & Hydro Power Equipment Manufacture Co. Ltd. for their supporting to the cooperative research on hydraulic machinery.

Sincere thanks to Hitachi Ltd including both Hitachi Industries Co. Ltd. and Hitachi Works, Mitsubishi Heavy Industries Co. Ltd., the Institute of Fluid Sciences of Tohoku University, and Kyushu Institute of Technology, for long time of cooperation.

The authors would highly appreciate the help of Profs. Naixiang Chen, Hongyuan Xu, Zhenwei Wang, Shuliang Cao, Yangjun Zhang, Jing Ren, Xianwu Luo, Baoshan Zhu (Tsinghua University), Profs. Jianzhong Xu (Academician), Jiezhi Wu, Cunbiao Lee, Qingdong Cai (Peking University), and Professors from China and other universities Sheng Zhou, Xingqi Luo, Shouqi Yuan, Zhenyue Ma, Fujun Wang, Guoyu Wang, Qingguang Chen, Lingjiu Zhou, Xuelin Tang, Jiandong Yang, Fengqin Han and Chao Yan. Drs. Jiang Dai, Zixiang Sun, Weizhang Wu, Jianming Yang, Wei Zhang, Zhaohui Xu, Liang Zhang, Yu Xu, Yuzhen Wu, Yong Li, Hongfen Tang, Shangfeng Wu, Penghui Xia, Xiaojing Wu, Jie Shao, Daqing Zhou, Wei Yang, Fan Yang, Guangjun Cao, Gang Chen, Zhaofeng Xu, Zhiping Li, and Jinwei Li have been long cooperated with the authors, their supports are gratefully acknowledged.

Special thanks to late Prof. Zuyan Mei and Prof. Ruchang Lin (Tsinghua University), Prof. Risaburo Oba (Tohoku University) for their guidance and advice, and to Profs. Teyu David Kao, Apostolos Goulas, D.-H. Hellmann, Michihiro Nishi, Hiroshi Tsukamoto, Yoshinobu Tsujimoto, Wei Shyy, Roger Leblanc, Michel Guilbaud, Kwang-Yong Kim, and Young-Ho Lee, and Drs. Peter Tillack, Berthold Matz, Baogang Wang, Tomoyoshi Okaomura, Takahide Nagahara, Kazuyoshi Miyagawa, Kazuo Niikura, and Jوشيro Sato for long cooperation and assistance. We would also like to thank Ms. Angela Omalley and Prof. David Kao, as well as Mr. Tiejun Chen and Ms. Ling Shen for their devoted effort into the language revision and check of this book.

Finally, thanks to the UK EPSRC's Warwick-IMRC for their financial support (R.ESCM.9001 and R.ESCM9004) on turbine technology and cavitation.

Yulin Wu

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