



INTELLIGENT FAULT DIAGNOSIS AND REMAINING USEFUL LIFE PREDICTION OF ROTATING MACHINERY

Yaguo Lei



Intelligent fault diagnosis
and remaining useful life prediction
of rotating machinery

INTELLIGENT FAULT DIAGNOSIS AND REMAINING USEFUL LIFE PREDICTION OF ROTATING MACHINERY

YAGUO LEI



西安交通大学出版社
XI'AN JIAOTONG UNIVERSITY PRESS



AMSTERDAM • BOSTON • HEIDELBERG • LONDON • NEW YORK • OXFORD
PARIS • SAN DIEGO • SAN FRANCISCO • SINGAPORE • SYDNEY • TOKYO

Butterworth-Heinemann is an imprint of Elsevier



CONTENTS

Preface	vii
Chapter 1 Introduction and Background	1
1.1 Introduction	1
1.2 Overview of PHM	7
1.3 Preface to Book Chapters	14
References	16
Chapter 2 Signal Processing and Feature Extraction	17
2.1 Introduction	17
2.2 Signal Preprocessing	20
2.3 Signal Processing in the Time Domain	27
2.4 Signal Processing in the Frequency Domain	31
2.5 Signal Processing in the Time-Frequency Domain	40
2.6 Conclusions	63
References	65
Chapter 3 Individual Intelligent Method-Based Fault Diagnosis	67
3.1 Introduction to Intelligent Diagnosis Methods	67
3.2 Artificial Neural Networks	69
3.3 Statistical Learning Theory	117
3.4 Deep Learning	144
3.5 Conclusions	170
References	171
Chapter 4 Clustering Algorithm-Based Fault Diagnosis	175
4.1 Introduction to Clustering Algorithm	175
4.2 Weighted K Nearest Neighbor-Based Fault Diagnosis	177
4.3 Weighted Fuzzy c-Means-Based Fault Diagnosis	196

4.4 Hybrid Clustering Algorithm-Based Fault Diagnosis	211
4.5 Conclusions	225
References	227
Chapter 5 Hybrid Intelligent Fault Diagnosis Methods	231
5.1 Introduction	231
5.2 Multiple WKNN Combination-Based Fault Diagnosis	232
5.3 Multiple ANFIS Hybrid Intelligent Fault Diagnosis	247
5.4 A Multidimensional Hybrid Intelligent Method	262
5.5 Conclusions	277
References	278
Chapter 6 Remaining Useful Life Prediction	281
6.1 Background	281
6.2 Data-driven Prediction Methods	283
6.3 Model-Based Prediction Methods	300
6.4 Conclusions	352
References	355
Glossary	359
Index	363