

# **Fifteenth International Conference on Condition Monitoring and Machinery Failure Prevention Technologies (CM 2018/MFPT 2018)**

Nottingham, United Kingdom  
10 - 12 September 2018

ISBN: 978-1-5108-7135-9

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2018) by British Institute of Non-Destructive Testing  
All rights reserved.

Printed by Curran Associates, Inc. (2018)

For permission requests, please contact British Institute of Non-Destructive Testing  
at the address below.

British Institute of Non-Destructive Testing  
Newton Building  
St. George's Avenue  
Northampton, NN2 6JB  
United Kingdom

Phone: 44 0 1604 89 3811

Fax: 44 0 1604 89 3861

[info@bindt.org](mailto:info@bindt.org)

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2633  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# TABLE OF CONTENTS

## SESSION IA – TRAINED STRUCTURES AND STATISTICAL METHODS IN CONDITION MONITORING

<b>ON THE APPROACHES TO ASSESSING THE SKILLS OF OPERATORS OF COMPLEX TECHNICAL SYSTEMS</b> .....	1
<i>L. Kuravsky, G. Yuryev</i>	
<b>DIMENSIONALITY REDUCTION WITH AID OF STOCHASTIC SWARM CLUSTERIZATION METHOD</b> .....	26
<i>G. Yuryev, E. Verkhovskaya, N. Yuryeva</i>	
<b>SELF-LEARNING ADAPTIVE TRAINING PROCEDURE FOR CM PERSONNEL</b> .....	38
<i>L. Kuravsky, A. Margolis, G. Yuryev, G. Pominov</i>	
<b>MONITORING THE DANGEROUS ACTIVITY OF COMPUTER NETWORK USERS</b> .....	44
<i>L. Kuravsky, G. Yuryev, P. Scribtsov, M. Chervonenkis, A. Konstantinovskiy, A. Shevchenko, S. Isakov</i>	
<b>CONVOLUTIONAL FEATURE EXTRACTION FROM HUMAN COMPUTER INTERACTION DATA IN BEHAVIORAL BIOMETRIC</b> .....	58
<i>G. Yuryev</i>	
<b>ON AN APPROACH TO ADAPTIVE TESTING IN PSYCHOLOGICAL MEASUREMENTS</b> .....	69
<i>L. Kuravsky, S. Artemenkov, G. Yuryev</i>	

## SESSION IB – NOVEL MONITORING APPLICATION

<b>SENSOR-LESS CONTROL OF A NOVEL STEPPED HYDRAULIC FLOW CONTROL VALVE</b> .....	83
<i>K. Abuowda, S. Noroozi, M. Dupac, P. Godfrey</i>	
<b>REAL-TIME INTERFACIAL LOAD MONITORING AND TRACKING BETWEEN THE COMPOSITE PROSTHETIC SOCKET AND RESIDUAL LIMB FOR BELOW-KNEE AMPUTEES</b> .....	92
<i>N. Aslani, S. Noroozi, P. Davenport, K. Abuowda</i>	
<b>KINEMATICS STUDY OF THE DELTOID IN REVERSE SHOULDER ARTHROPLASTY USING STANDARD PRE AND POST-OPERATIVE XRAYS</b> .....	102
<i>N. Aslani, S. Noroozi, R. Hartley, A. Harvey, P. Sewell</i>	
<b>FRICTION ANALYSIS AND MODELLING OF A NOVEL STEPPED ROTARY FLOW CONTROL VALVE</b> .....	117
<i>K. Abuowda, I. Okhotnikov, S. Noroozi, P. Godfrey</i>	

## SESSION 2A – TRAINED STRUCTURES AND STATISTICAL METHODS IN CONDITION MONITORING

<b>FORECASTING BEHAVIOR OF A STOCHASTIC MULTI-AGENT SYSTEM</b> .....	129
<i>L. Kuravsky, S. Popkov</i>	
<b>FORECASTING AVIATION ACCIDENTS WITH THE AID OF PROBABILISTIC MODELS</b> .....	138
<i>P. Dumin, D. Pominov</i>	

## SESSION 2B – MACHINE LEARNING

<b>POWER CURVE MODELING USING SUPPORT VECTOR MACHINE AND ITS ACCURACY DEPENDENCE ON KERNEL SCALE</b> .....	145
<i>R. Pandit, D. Infield</i>	
<b>PUMP CAVITATION DETECTION THROUGH FUSION OF SUPPORT VECTOR MACHINE CLASSIFIER DATA ASSOCIATED WITH VIBRATION AND MOTOR CURRENT SIGNATURE</b> .....	157
<i>B. Yari, M. Safizadeh</i>	

### **SESSION 3A – TRAINED STRUCTURES AND STATISTICAL METHODS IN CONDITION MONITORING**

<b>APPLICATION OF THE METHOD OF PATTERNS IN CONDITION MONITORING .....</b>	<b>170</b>
<i>L. Kuravsky, G. Yuriev, D. Pominov, N. Yurieva</i>	
<b>USECASES OF BLOCKCHAIN CRYPTOGRAPHIC HASH FUNCTIONS FOR DATA MONITORING INTEGRITY ENSURING .....</b>	<b>178</b>
<i>A. Kulakov, V. Milov, A. Semashko</i>	
<b>ABOUT EFFECT OF SHAFT UNBALANCE AND SUPPORTS MISALIGNMENTS TO THE BORDER OF ROTATION STABILITY OF THE EXPERIMENTAL FOUR SUPPORT SHAFT .....</b>	<b>191</b>
<i>A. Kumenko, A. Timin, N. Kuzminykh, S. Medvedev</i>	

### **SESSION 3B – NDT AND SHM METHODS**

<b>OPPORTUNITIES OF X-RAY TESTING WITHOUT INTERMEDIATE DATA CARRIERS OF INFORMATION .....</b>	<b>204</b>
<i>V. Troitskiy</i>	

### **SESSION 3C – SIGNAL PROCESSING, ICT AND CONDITION MONITORING**

<b>EDGE COMPUTING AND MACHINE CONDITION MONITORING .....</b>	<b>213</b>
<i>R. Smid</i>	
<b>MANAGING YOUR SUPPLY CHAIN MUST INCLUDE THE MONITORING OF THE EFFECTIVE DELIVERY OF ENERGY .....</b>	<b>217</b>
<i>J. Butler</i>	
<b>RESEARCH ON SPECTRUM COMPONENTS OF PLANETARY GEARBOX VIBRATION SIGNALS BY DYNAMIC MODELING AND FILTERING .....</b>	<b>220</b>
<i>L. Zhang, N. Hu, L. Hu, Z. Cheng</i>	

### **SESSION 4A – VIBRATION ANALYSIS, DIAGNOSTICS AND PROGNOSTICS – INDUSTRIAL CASE STUDIES**

<b>UPDATE ON ISO STANDARDS IN CONDITION MONITORING AND VIBRATION.....</b>	<b>230</b>
<i>S. Mills</i>	

### **SESSION 4C – SIGNAL PROCESSING: FAULT DIAGNOSIS FOR COMPLEX SYSTEM MONITORING**

<b>VIBRATION RESPONSE DEMODULATION, SHOCK MODEL AND TIME TRACKING .....</b>	<b>251</b>
<i>X. Laval, N. Martin, P. Bellemain, Z. Li, C. Mailhes, C. Pachaud</i>	
<b>VIBRATION-BASED HEALTH MONITORING METHODOLOGY FOR HELICOPTER GEARBOXES .....</b>	<b>265</b>
<i>Y. Marnissi, D. Abboud, M. Elbadaoui</i>	

### **SESSION 4D – IN MEMORY OF THE LATE PROFESSOR V KOSTYUKOV: CONDITION MONITORING METHODS AND TECHNOLOGIES**

<b>SOME PROBLEMS OF VIBRATION-BASED HEALTH MONITORING .....</b>	<b>277</b>
<i>A. Kostyukov, S. Boichenko, A. Naumenko</i>	
<b>THE BIG DATA TECHNOLOGY IN REAL-TIME CONDITION MONITORING SYSTEMS .....</b>	<b>291</b>
<i>A. Kostyukov, S. Boichenko</i>	

**SESSION 4A CONTINUED – VIBRATION ANALYSIS, DIAGNOSTICS AND PROGNOSTICS – INDUSTRIAL CASE STUDIES**

WIRELESS NOISE CHARACTERISTICS ON GEARBOXES DUE TO SPEED VARIATIONS ..... 297  
*P. Raharjo, Y. Sofyan, T. Arif*

**SESSION 4C CONTINUED – SIGNAL PROCESSING: FAULT DIAGNOSIS FOR COMPLEX MONITORING**

COMPARISON OF ELECTRICAL AND VIBRATION ANALYSIS METHODS FOR MECHANICAL FAULT MONITORING IN WIND TURBINE DRIVE TRAINS ..... 307  
*P. Granjon, P. Lonhitano, A. Singh*

PISTON LEAK DETECTION IN AN AXIAL PISTON PUMP USING PRESSURE AND VIBRATION SIGNALS..... 318  
*D. Bensaad, F. Guillet, A. Soualhi*

LOCATING FAULTY PLANET GEARS USING EXTERNAL VIBRATION MEASUREMENTS..... 330  
*D. Peng, W. Smith, R. Randall*

**PLENARY LECTURE**

A JOURNEY FROM NDT TO CM ..... 339  
*T. Holroyd*

EVERY PASSENGER, EVERY BAG, EVERY TIME WITH CONDITION BASED MONITORING ..... 359  
*G. Conaghan, D. Haines*

**SESSION 5B – ACOUSTIC EMISSION**

LAMB WAVE MODELLING AND EXPERIMENTAL STUDY ON ACOUSTIC EMISSION USING ANSYS..... 376  
*A. Ghouri, D. Hutson, K. Kirk*

**SESSION 5C – ADVANCED CM AND DIAGNOSTICS FOR SMART SYSTEMS**

GENERALISED STATISTICAL PROCESS CONTROL (GSPC) IN CONDITION MONITORING ..... 385  
*E. Juuso*

OPTICAL MEASUREMENTS FOR FLOTATION MONITORING AND DIAGNOSTICS..... 397  
*M. Paavola, K. Rahkamaa-Tolonen, M. Okkonen*

BIG DATA FOR PREDICTIVE MAINTENANCE OF INDUSTRIAL MACHINERY ..... 405  
*A. Koistinen*

**SESSION 5D – ADVANCED METHODOLOGIES FOR DIAGNOSTICS OF ROTATING MACHINERY**

DETECTION OF A NATURAL FAULT IN BALL BEARING DURING ENDURANCE TEST BY OPTICAL FIBER SENSORS..... 416  
*D. Shimoni, D. Gazizulin, H. Alian, R. Klein, M. Tur, J. Bortman*

CRACK DETECTION IN SHAFTS VIA ANALYSIS OF VIBRATIONS AND ORBITAL PATHS: A COMPARISON ..... 428  
*L. Rogel, R. Peretz, J. Bortman, R. Klein*

**SESSION 6A – OCM LUBRICATION AND WEAR DEBRIS ANALYSIS**

FUNDAMENTALS OF OIL DEBRIS DETECTION AND REPORTING ..... 439  
*S. Greenfield*

## **SESSION 6C – ADVANCED CM AND DIAGNOSTICS**

<b>EXTRACTING PERIODICALLY REPEATING SHOCKS IN A GEARBOX FROM SIMULTANEOUSLY OCCURRING RANDOM VIBRATION.....</b>	<b>456</b>
<i>K. Karioja, S. Lahdelma, G. Litak, B. Ambrozkiwicz</i>	

## **SESSION 6D – ADVANCED METHODOLOGIES FOR DIAGNOSTICS OF ROTATING MACHINERY**

<b>THE EFFECT OF GREASE LEVEL AND BACKLASH ON THE AH-64 INTERMEDIATE GEARBOX USING A UNIQUE TEST RIG .....</b>	<b>465</b>
<i>N. Silverman, I. Dadon, J. Bortman, A. Kushnirsky, D. Meron, R. Klein</i>	

## **SESSION 7A - CONDITION MONITORING METHODS AND TECHNOLOGIES**

<b>THE EFFECT OF THE WEAR EVOLUTION ON VIBRATION BASED FAULT DETECTION IN TAPERED ROLLER BEARINGS.....</b>	<b>475</b>
<i>K. Rabeyee, X. Tang, F. Gu, A. Ball</i>	

## **SESSION 7B – SIGNAL PROCESSING: FAULT DIAGNOSIS FOR COMPLEX SYSTEM MONITORING**

<b>KALMAN FILTERING USING TRIGONOMETRIC POLYNOMIALS FOR THE GEAR FAULT DIAGNOSIS UNDER A VARIABLE SPEED CONDITION .....</b>	<b>487</b>
<i>A. Assoumane, E. Sekko, P. Ravier</i>	
<b>MONITORING SYSTEM FOR CABLE TRANSPORTATION .....</b>	<b>498</b>
<i>N. Saguin-Spryinski, L. Jouanet, M. Billeres</i>	

## **SESSION 7C – DIAGNOSTICS BASED ON TRIBO-VIBROACOUSTIC ANALYSIS**

<b>MONITORING THE TRIBOLOGICAL BEHAVIOUR OF PISTON RING-CYLINDER LINER IN A FOUR-CYLINDER DIESEL ENGINE BY USING ACOUSTIC EMISSION SIGNALS.....</b>	<b>508</b>
<i>Y. Xu, J. Fei, F. Gu, A. Ball</i>	
<b>INFLUENCE OF FRICTIONAL EXCITATIONS ON THE DIAGNOSTIC FEATURES OF HELICAL GEARS UNDER DIFFERENT OPERATING CONDITIONS .....</b>	<b>522</b>
<i>X. Sun, T. Wang, R. Zhang, F. Gu, A. Ball</i>	
<b>FAULT DIAGNOSIS OF PLANETARY GEAR DRIVE SYSTEM BASED ON SPARSE DECOMPOSITION OPTIMIZED BY GENERALIZED MATCHING PURSUIT ALGORITHM .....</b>	<b>533</b>
<i>Z. Zhu, Z. Wang, D. Zhen, H. Zhang, Z. Shi, F. Gu</i>	

## **SESSION 8B – CONDITION MONITORING AND NDT METHODS**

<b>THE DETECTION OF SMALL CRACK ON STEEL SURFACE USING EDDY CURRENT PULSED THERMOGRAPHY .....</b>	<b>542</b>
<i>X. Xu, J. Ma, Z. Wang, D. Zhen, H. Zhang, Z. Shi</i>	

## **SESSION 8C – DIAGNOSTICS AND PROGNOSTICS BASED ON TRIBO-VIBROACOUSTIC ANALYSIS**

<b>RUL PREDICTION APPROACH OF FATIGUE CRACK BASED ON PHYSICS MODEL FOR PLANETARY GEAR SET OF HELICOPTER.....</b>	<b>551</b>
<i>Z. Cheng, N. Hu, L. Zhang, M. Gao</i>	

**ADDITIONAL PAPERS**

**WIRELESS CONDITION MONITORING – RELIABILITY ENHANCEMENT OF REMOTE  
EQUIPMENTS BY WEB BASED INNOVATION AT DTPS..... 560**  
*H. Bari, A. Deshpande, S. Patil*

**A LOGICAL REASONING APPROACH FOR FAILURE DATA ANALYSIS..... 569**  
*E. Kotelnikov, V. Milov*

**Author Index**