SVIB
VIBRATIONS
NYTT

Medlemsblad för Skandinaviska Vibrationsföreningen
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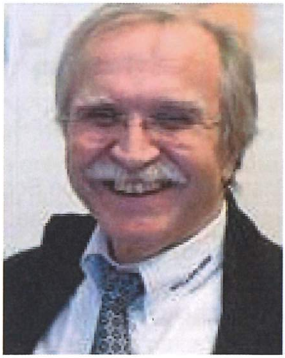
Innehållsförteckning

Annonskostnad för 2 nr (exkl moms)	
Dubbeluppslag	10000 SEK
Baksida	7000 SEK
Hel insida	5000 SEK
Halvsida	3000 SEK

Medelmsavgift:	550 SEK
Pensionärer	280 SEK

Foto framsida Lena van Evelingen

Ordföranden har ordet



Som jag nämnde i förra numret har vi nu verksamhetsåret ändrat till kalenderår och därmed hamnar årsmöte och vibrationsdag hädanefter på vårkanten istället för mitt i november och höstrusk. Vi har i år samordnat vibrationsdagen med en 3-dagars kurs i avancerad vibrationsmätning och analys som ni kan läsa om i detta nummer. Likaså kan nu företag söka medlemskap om man har flera medarbetare som vill vara med i SVIB. Information om företagsmedlemskap återfinns också i detta nummer.

I skrivande stund är vi mitt i en besynnerlig vinter åtminstone i Göteborg. Förutom några veckor i januari lyser vintern vädermässigt med sin frånvaro en bit in i februari. Det har känts som en mycket sen höst har förbytts i en tidig föraning om vår. Hoppas att vi har fint vårväder i Köpenhamn när april avlöser mars och SVIB:s evenemang går av stapeln.

Vi jobbar fortfarande med att få ordning på föreningens medlemsregister samtidigt som en ny hemsida är försenad där medlemmarna själva skall kunna gå in och uppdatera sina personliga uppgifter, anmäla sig till våra arrangemang mm.

Som ansvarig för Svib-nytt avslutar jag återigen med att gnälla. Innehållet i vårt medlemsblad hänger på att ni försöker bidra med material. Ni har säkert noterat att det bara blev ett istället för tre nummer av SVIB-nytt 2013.

Orsaken är att jag som redaktör inte fått in tillräckligt med bidrag för att få ett något sånär fylligt nummer förrän nu. Jag hoppas ändå att det nummer ni håller i handen är läsvärd, men den kunde varit ännu bättre om ni alla inte bara funderade på med vad ni kunde bidra utan kanske också kan lägga lite tid på att få ihop några sidor om t ex vad ni sysslar eller har sysslat med. Det behöver inte vara speciellt märkvärdigt. Jag tror att bredden på artiklar, notiser och inlägg skulle må bra av det. Det är inte svårare än att skicka ett mail till juha.plunt@muellerbbm.se och få det publicerat i nästa nummer.

Det har också varit svårt att få våra annonsörer att skriva ihop ett par sidors presentation av sina företag. Det vore trevligt att få veta mer om dem som ligger bakom annonserna. Jag vill påminna dem om den gratisreklam-möjligheten. Jag tar mig friheten i detta nummer att demonstrera hur enkelt det kan se ut genom att presentera Gothenburg Sound AB där jag utvecklar och marknadsför mitt SEA-program.

En skön vår och sommar önskar Juha.

Konferenser

First invitation to

SVIB Vibrations days 2014

2-3 April, Copenhagen

The Scandinavian Vibration Society (SVIB) welcomes you to some exciting and very interesting meeting days at the Tycho Brahe Planetarium in Copenhagen.

SVIB also arranges a 3-day Seminar on"Advanced Vibration Testing and Analysis" immediately before the annual Vibration Day. The last day of the seminar is also held at the Planetarium and can be attended also as a SVIB Theme Day – "Advanced Industrial Application Examples of Testing and Analysis".

More information about the Planetarium is at http://www.planetariet.dk/

Monday, March 31st: Seminar, Day 1, Basics: Introduction and Tutorial, held at DTH
Tuesday,, April 1st: Seminar, Day 2, Advanced Topics, held at DTH
Wednesday, April 2nd: Seminar, Day 3 and SVIB Theme Day – Advanced Industrial Application Examples
Thursday, April 3rd: SVIB common vibration day and annual member meeting.

In addition to a technical program, there will be an exhibition of products and services with time for contacts during the breaks. Exhibitors are also given time for a short presentation on Thursday. Note that presentations may be in English or a Scandinavian language (Danish/Norwegian/Swedish)

A detailed technical program for the common vibration day will be available at the end of February. It will be posted on our web site www.svib.se as well as a number of LinkedIn groups.

Call for presentations at SVIB Vibration Day

If you have anything interesting to present for your peers and want to hold a short informal presentation (20-25 min) at the Vibration Day then send an e-mail to juha.plunt@muellerbbm.se before February 24th. We only need a title and the name and affiliation of the presenter. The presentation does not have to be unique and may be presented before. No written paper is necessary or any documentation afterwards. If you want to write a short paper we will gladly publish it in SVIB-nytt.

Registration

Application to the Vibration Day 2014 on April 3rd and the Theme Day on April 2nd is done by sending an email to Svib@acoutronic.se latest March 20th 2014. If a company pays the fee, the following shall be included:

- Company name and corporate identity
- Complete billing address
- Order number and order number (if required for billing)
- Name of Participant

Participation fee

	SVIB Member Before March 1st	SVIB Member After March 1st	University Student	Not a SVIB Member*
For both days	SEK 5000	SEK 5500	SEK 2500	Add SEK 600
For Vibration Day only	SEK 2000	SEK 2500	SEK 1000	Add SEK 600

* Includes one year membership fee.

The participation fee for both days also includes the conference dinner.

Invitation to exhibitors

If you want to participate in the exhibition during the two days, then contact Torbjörn Kloow, svib@acoutronic.se. Fee for exhibition booth (ca 6-8 m^2): SEK 5000. The fee includes participation in the lectures and the conference dinner for one person.

The booth has electricity, table(s) and chairs. If you need anything extra, please mail your request to Anders Olsen, ao@vibratec.dk. If you need a larger booth (twice the size) the additional fee is SEK 1500.

April 2nd – Theme Day: Test and Analysis - Advanced Industrial Application Examples

09.00 – 09.30 Registration, morning coffee

09.30 – 10.30 Commercial multichannel systems. The increasing role of metadata for quality assurance, traceability and harvesting of large data sets.
Stefan Kremer, Müller-BBM VibroAkustik Systeme GmbH

10.30 – 11.30 Transfer path analysis, force based and operational with case examples.
Filip Deblauwe, LMS International N.V.

11.30 – 12.30 Specific test and analysis methods for rotor dynamics.
Jean-Claude Luneno, ÅF AB, Sound & Vibration

12:30 – 13:30 Lunch and exhibition visits

13.30 – 14.30 Vibrationsövervakning av vertikala maskiner med glidlager.
Mattias Nässelqvist, ÅF AB, Sound & Vibration

14.30 – 15.30 Operational modal analysis: how and examples of successful applications.
Javier Garcia Lopez, LMS International N.V.

15:30 – 16:00 Afternoon coffee and exhibition visits

16.00 – 17.00 Testing and analysis of vibration isolation systems and non-rigid supporting structures.
Juha Plunt, Müller-BBM Scandinavia AB

17.00 – 17:50 Movie show – Planetarium

19:00 - Conference dinner

April 3rd – SVIB Vibration Day (Detailed program in 2nd invitation)

08.30 – 10.00 SVIB Annual Meeting

10.00 – 10.30 Morning coffee and exhibition visits

10.30 – 11.15 Invited presentation

11.15 – 11.45 Exhibitor presentations

11.45 – 13.00 Lunch and exhibition visits

13.00 – 13.30 Contributed presentation

13.30 – 14.00 Contributed presentation

14.00 – 14.30 Contributed presentation

14:30 – 15:00 Afternoon coffee and exhibition visits

15.00 – 15.30 Contributed presentation

15.30 – 16.00 Contributed presentation

Årsmöte i Skandinaviska Vibrationsföreningen, SVIB

Torsdagen 3 april 2014 på Tycho Brahe Planetarium i Köpenhamn.

Dagordning

a) Fastställande av dagordning
b) Val av mötesordförande och mötessekreterare
c) Val av justeringsmän för dagens protokoll
d) Fråga om stämman blivit behörigen kallad
e) Avgående styrelsens redogörelse för verksamheten under det föregående verksamhetsåret
f) Revisionsberättelse
g) Fastställande av resultat- och balansräkningar
h) Beslut rörande ansvarsfrihet för den avgående styrelsen
i) Fastställande av budget för kommande verksamhetsår
j) Fastställande av föreningens årsavgift för medlemmar och pensionärer
k) Val av ordförande för tiden t o m nästkommande årsmöte
l) Val av vice ordförande för tiden t o m nästkommande årsmöte
m) Val av sekreterare
n) Val av skattmästare
o) Val av övriga styrelsemedlemmar
p) Val av två revisorer och revisorssuppleant
q) Tillsättande av en valberedning
r) Övriga ärenden

Diskussion om hemsida och medlemsregister
Hur kan vi få medlemmarna att bidraga mer aktivt till SVIB-nytt och Vibrationsdag?

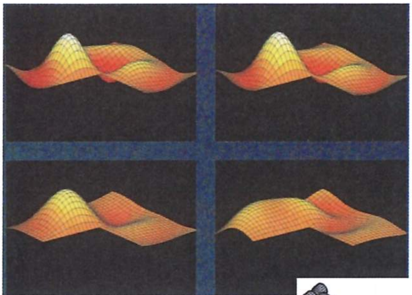
SVIB Seminar
Advanced Vibration Testing and Analysis
Copenhagen, Denmark, March 31 – April 2, 2014

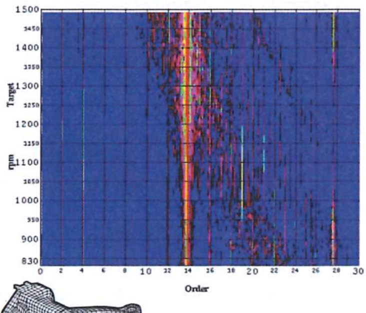
The Scandinavian Vibration Society (SVIB) invites you to attend a three day seminar on vibration testing and analysis. It is a long time since the last special SVIB seminar was held with the aim to provide advanced lectures on a vibration subject. We hope that you will find this one interesting to join and to meet other collegues with a common interest in vibration testing and analysis.

The first day covers a basic tutorial intended for engineers who are relatively new to the field of vibration testing, analysis and control or others who want to "brush up" the fundamentals.

The second day goes deep into advanced, contemporary practical technology and the final third day discusses a number of Advanced Industrial Application Examples.

The venue for the two first days is DTU, Technical University of Denmark in Lyngby just north of Copenhagen. The third day will take place at Tycho Brahe Planetarium in the center of Copenhagen, followed at April 3rd by the 2014 SVIB Vibration Day.





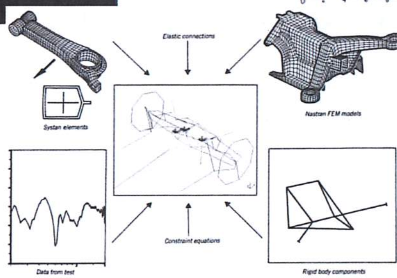


Fig 8. Principal building block approach for dynamic modelling by SYSTAN.

March 31st – Basics: Introduction and Tutorial

9.00-10.00	What is vibration and its analysis? Vibration mechanisms, vibration areas, mechanical vibrations summary **Elisabet Blom, Qring Technology AB**
10.00 – 12.00	Signal analysis Time signal analysis, spectrum analysis, FFT based methods, octave spectra **Anders Brandt, University of Southern Denmark**
12:00 – 13:00	Lunch
13:00 – 16:00	Signal analysis (continues) **Anders Brandt, University of Southern Denmark**
16.00 – 18.00	Vibration test and analysis at higher frequencies: Specific issues, test and analysis methods, vibro-acoustic challenges **Juha Plunt, Müller-BBM Scandinavia AB**

April 1st – Advanced Topics

8.00 – 10.00	Current multi-channel time and frequency analysis methods **Juha Plunt, Müller-BBM Scandinavia AB**
10.00 – 12.00	Rotating machinery analysis Rotor dynamics theory, order tracking, orbit analysis **Elisabet Blom, Qring Technology AB**
12:00 – 13:00	Lunch
13.00 – 14.00	Operational deflection shapes, why and how? **Anders Brandt, University of Southern Denmark**
14.00 – 16.00	Modal analysis Pretest, setup, measurements, parameter extraction, experimental and operational **Anders Brandt, University of Southern Denmark**
16.00 – 17.00	Principal component analysis Principle source ranking, data reduction, operating transfer path analysis **Mihkel Toome, Müller-BBM Scandinavia AB**
17.00 – 18.00	Damping measurement and analysis methods for materials, components and built up systems **Anders Olsen, Vibratec A/S**
19:00 -	Seminar dinner

April 2nd – Advanced Industrial Application Examples

08.00 – 09.00	Commercial multichannel systems. The increasing role of metadata for quality assurance, traceability and harvesting of large data sets. **Stefan Kremer, Müller-BBM VibroAkustik Systeme GmbH**
9.00 – 10.00	Transfer path analysis, force based and operational with case examples **Filip Deblauwe, LMS International N.V.**
10.00 – 11.00	Specific test and analysis methods for rotor dynamics **Jean-Claude Luneno, ÅF AB, Sound & Vibration**
11.00 – 12.00	Vibrationsövervakning av vertikala maskiner med glidlager **Mattias Nässelqvist, ÅF AB, Sound & Vibration**
12:00 – 13:00	Lunch
13.00 – 14.00	Operational modal analysis: how and examples of successful applications **Javier Garcia Lopez, LMS International N.V.**
14.00 – 15.00	Testing and analysis of vibration isolation systems and non-rigid supporting structures **Juha Plunt, Müller-BBM Scandinavia AB**

Literature

Anders Brandt: "Noise and Vibration Analysis – Signal Analysis and Experimental Procedures," published by Wiley 2011, is used as the primary literature. Presentation material and additional lecture notes on the special subjects are also included in the seminar documentation (as PDF-files).

Exhibition

A number of suppliers of test equipment and systems will exhibit their products in connection to the seminar on April 2nd and the Vibration day April 3rd at the Planetarium.

Seminar Fee

SVIB is a non-profit society and the fees are held as low as possible to cover the cost of the seminar:

	SVIB Member Before March 1st	**SVIB Member After March 1st**	**Not a SVIB Member***	**Price for SVIB Vibration day**
For all three days	SEK 8000	SEK 9000	Add SEK 600	Add SEK 1000
For any two days	SEK 6000	SEK 7000	Add SEK 600	Add SEK 1500
For any single day	SEK 3000	SEK 3500	Add SEK 600	Add SEK 2000

* Includes one year membership fee.

The reduced price for attending the Vibration Day applies only when your register to the seminar (normal fee is SEK 2500).

For PhD students: A university may register 2 PhD students for the price of one, given above.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You can register to svib@acoutronic.se before March 24, 2014. We need the following information:

- Your name and company to be invoiced.
- Invoicing address and purchase order number if applicable.
- Which of the above mentioned alternatives for participation that applies.
- Which of the days that you intend to participate.

The first two seminar days may be postponed if the number of registered attendants on March 24 is too small for the first two days.

The third day will be held in any case as a special theme day in conjunction with the vibration day.

Lecturers

Prof. Anders Brandt: *Prof Brandt has over twenty five years of industrial and academic experience as a consultant and teacher in applications of signal analysis in acoustics, experimental structural dynamics and mechanical wave propagation in structures. He is running the website abravibe.com with additional resources for teaching, learning, and applying vibration analysis. Anders is a devoted and appreciated teacher and has held over 250 short-courses for industry around the world, on topics such as data acquisition, vibration analysis, and modal analysis, besides 15 years of teaching university courses. He is presently Associate Professor at the University of Southern Denmark.*

M.Sc. Elisabet Blom: *graduated from Linköping University in classic mechanics and thermo dynamics. She has more than twenty years of vibration measurements in field applications. She has worked with practical rotor dynamics and structure dynamics. Since 7 years she owns and works at Qring Technology International. During 20 years she has participated as a lecturer in Linköping University and in short courses on practical parts of structure dynamics. At present she has most her assignments in the Swedish nuclear industry.*

Dr. Filip Deblauwe*: Graduated from University of Cincinnati with a PhD in Modal Analysis. Dr. Deblauwe joined LMS International in 1991 and has been most of his time Product Manager and Business Development Manager for Acoustics & Structural products. Since 2011, Dr. Deblauwe is with LMS HQ sales as Technical Manager supporting sales with Pre sales activities and also mentoring the budding pre-sales engineers*

M.Sc. Stefan Kremer*: graduated from the Institute of Human-Machine-Interaction (MMK), Munich University of Technology, with a Dipl.-Ing. in Technical- and Psychoacoustics. After his final thesis at the Munich-based national research institute for broadcasting technologies (IRT), Stefan Kremer joined Müller-BBM VibroAkustik Systeme as a sales engineer in 2002. According to the company's philosophy, he focuses his work on tailor-made solutions to solve complex NVH tasks. Still having sales responsibilities for numerous key accounts in Germany, Austria and Switzerland, Stefan Kremer since 2012 is in charge of direct and indirect sales in South Africa, India and Scandinavia (since 2013).*

M.Sc. Javier Garcia Lopez: *graduated from Institute of Sound and Vibration Research (ISVR), University of Southampton, with a M.Sc in Sound and Vibration. After a short stint working in Spain for building acoustics lab at University of Madrid, and a research collaboration with K.U. Leuven and Cochlear ltd, Javier joined LMS in 2011 as a Customer Services Engineer, providing post-sales support and customer trainings. Javier joined the LMS HQ sales team as an Application Engineer in 2013, supporting sales with Pre-sales activities.*

Dr. Jean-Claude Luneno: *Dynamics of rotating machines. Before he joined ÅF Sound & Vibrations, Dr. Jean-Claude did research in "Coupled vibrations and parametric instability in Rotating machines"*

Dr. Mattias Nässelqvist: *Graduated from Luleå University of Technology with a PhD in Rotordynamics. Dr. Nässelqvist worked as a Research Engineer at Vattenfall R&D from 2004 to 2013 and joined ÅF in 2013 as Technical Consultant. Dr. Nässelqvists main tasks at Vattenfall and ÅF have been rotordynamic simulations and development of vibration monitoring methods applied to vertical hydropower units.*

M.Sc. Anders Olsen: *Graduated at the technical university of Denmark in 1992 with a M.Sc. degree at the Acoustics laboratory. Anders Olsen has been working many years as acoustic consultant with structural acoustics and dynamics. Since 2002-2008 working in Industrial Acoustics Company (IAC) as Head of the vibration department. Since 2008 working in Vibratec Akustikprodukter as technical director with technical sales and projects and R&D responsible.*

Dr. Juha Plunt*: Graduated at Chalmers University of Technology 1980 with a PhD in Applied Acoustics. Juha has mainly been working as a sound and vibration specialist at major specialized companies like Ingemansson, Müller-BBM specializing mainly on structure-borne sound and vibration related projects. He was also in charge of the NVH attribute engineering group at Volvo Car Corporation for many years. He was an adjunct professor at the Applied Acoustics department at Chalmers between 1993 and 2001. He works now as Principal Specialist at Müller-BBM Scandinavia AB.*

M.Sc. Mihkel (Mikk) Toome: *Graduated as B.Sc. at McMaster University, Canada in 2004 and as M.Sc. in sound and vibration at Chalmers 2012. Mikk has many years of professional expertise in acoustics, sound and vibration engineering including control of structural vibrations and structure-borne sound in buildings, bridges, machinery and vehicles. His thesis was Operational TPA which involves principal component analysis. He works now as Sound and Vibration Specialist at Müller-BBM Scandinavia AB.*

Standardisering

Informasjon om utgivelser av nye Norsk Standard i

NS 8141-serien

Følgende norske standarder er nå utgitt og er tilgjengelig på NS-katalogen:

NS 8141-1:2012+A1:2013, Vibrasjoner og støt - Veiledende grenseverdier for bygge- og anleggsvirksomhet, bergverk og trafikk - Del 1: Virkning av vibrasjoner og lufttrykkstøt fra sprengning på byggverk, inkludert tunneler og bergrom (Desember 2013)
NS 8141-2:2013, Vibrasjoner og støt - Veiledende grenseverdier for bygge- og anleggsvirksomhet, bergverk og trafikk - Del 2: Virkning av vibrasjoner på byggverk fra annen anleggsvirksomhet enn sprengning, og fra trafikk (Desember 2013)
Veiledningen til NS 8141-1:2012+A1 og NS 8141-2 er tilgjengelig på nettkatalogen fra i dag.

prNS 8141-3, Vibrasjoner og støt - Veiledende grenseverdier for bygge- og anleggsvirksomhet, bergverk og trafikk - Del 3: Virkning av vibrasjoner fra sprengning på utløsning av skred i kvikkleire, er til avsluttende behandling i komiteen SN/K293 etter nasjonal høring.

Spørreundersøkelse:
Det pågår også analyser av resultater etter en spørreundersøkelse som er utført ved boliger nær bygge- og anleggsarbeidsplasser i Norge.
Undersøkelsen handler om sjenanse/ plagegrad/ av vibrasjoner fra bygge- og anleggsarbeid, spesielt sprengninger.
Undersøkelsen er blitt utført av TØI i samarbeid med NGI og SN/K293 i årene 2011-2013. Resultatene av undersøkelsen er ventet i slutten av januar, og det vil bli utarbeidet et tillegg til NS 8141-1 om virkninger av vibrasjoner på mennesker.

DEBATT Den nya sprängstandarden SS 460 4866:2011 edition 3 är inte tillämpbar i dagens läge. En ny version måste skyndsamt tas fram! För att göra det behöver en allsidig grupp tillsättas, där bland annat representanter från Naturvårdsverket ingår.

Av HENRY SANDSTRÖM

Den nya sprängstandarden håller inte måttet

År 1972 TOG JAG initiativet till en ansökan till Byggforskningsrådet, BFR, om att få ett anslag som finansiering för framtagande av en "Standard" för sprängning. Medsökande var Skanska AB och dåvarande Akustikbyrån AB.

Genom remiss till dåvarande Planverket av ansökan väckte den ett sådant allmänt intresse att IVA satsade på projektet. IVA tillhandahöll en sekreterare för standardgruppen. Projektet pågick i cirka sex år med IVA som huvudman, varefter huvudmannaskapet gick vidare, först till SEK och sedan till BST, samt år 2008 till SIS. I över 35 år har jag således helt ideellt deltagit i standardarbetet.

SIS övertog standardarbetet år 2008. SIS Ag 3 satte igång en revidering av SS 460 4866 version 2, 1991. Tyvärr måste jag konstatera att revideringen inte har följt den handlingsplan som togs under SVIBs temadag 2008, där 65 representanter från konsultsidan deltog.

Sprängning under ett hus i Djursholm. Foto: Henry Sandström

Kyrka skadas av sprängningar

I april 2011 publicerade SvD en artikel om "Citytunneln" och riskerna för sprängningar i samband med stationsbyggnaden och tunneln vid Odenplan. Framför allt lyfte artikeln upp de stora riskerna för skador på den intilliggande Vasakyrkan och dess värdefulla och känsliga altartavla.

Efter åtta års projektering av Citybanan uttalade sig Statens fastighetsverk i artikeln och representant för Svenska kyrkan om sin rädsla för skador.

De gick då plötsligt med nyvaknat intresse in som representanter i SIS Ag 3: i slutskedet för revidering av SS 460 4866. Även Riksantikvarieämbetet kom med i standardarbetet. Enligt protokollen kom dessa representanter att dominera, med deras syn på för historiska och kulturella byggnader.

Riskerna hade bemästrats

Med 40 års erfarenhet av sprängstandard och stora projekt, vill jag hävda att jag hade, med nuvarande standard som grund, kunnat bemästra dessa risker för historiska och kulturella byggnader.

Min erfarenhet av sprängstandard SS460 4866 från de projekt jag har deltagit i inom Stockholmsområdet, där alla standarder har tillämpats fullt ut, är att knappt några skador registrerats vid efterbesiktningar.

På 1970-talet gällde det exempelvis en nybyggnad på Blasieholmen åt SAF, en kontors- och konferensbyggnad vägg i vägg med Grand hotell, och i närområdet till byggnaden Nationalmuseum med dess kulturvärden.

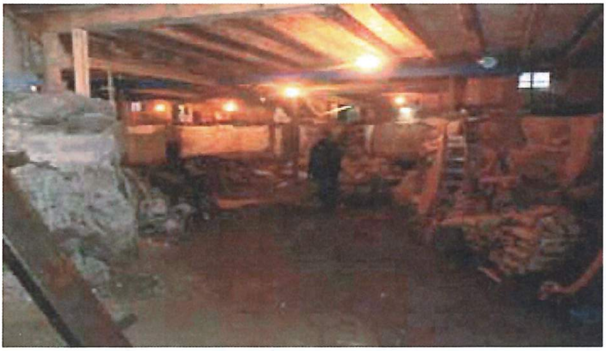
I tillämpningen av Sprängstandarden tidigare version, är det inget nytt att "Kultur och historiska byggnader" ingick med sina regler i SS460 4866 som grund för vår bedömning av risker för skador från aktuell sprängning.

Men det viktigaste i sammanhanget är den så kallade syneförrättningsstandarden SS460 4860, och att den följs med tanke på skadelidande tredje mans rätt till ersättning för en skada som uppstått genom utförd sprängning.

Avvek från revideringsplan

Utan att gå in på detaljer, så följdes inte beslutad plan för revideringen i den slutliga version 3 av standarden.

Jag nöjer mig att påpeka enbart en viktig punkt, nämligen 3.2 "Risker förenade med geologiska förhållanden". Under denna punkt är även grundvatten- och



Sprängning i källare. Djursholm. Foto: Henry Sandström

stabilitetsproblem medtagna, samt sättningskontroll. Dessa problem och kontroller utfördes vid projekteringen av till exempel Trafikverket efter ett utarbetat system i samråd med länsstyrelsen.

Allsidig grupp

Det har framkommit att dessa problem med geologi och grundvattenfrågor allmänt försummas inom övriga byggbranschen.

Det behövs därför ett utvidgat agerande på detta område för hela branschen.

Den nya standarden är svår att tillämpa i nuvarande skick! Problemet har uppmärksammats av en grupp hos SIS Ag 3 och ett möte hölls den 18 januari 2012 för skapande av en helt ny Sprängstandard SS 460 4866.

Till detta standardarbete behövs en allsidig grupp, som berörs av sprängning både som beställare och entreprenörer. Till standardgruppen bör även representanter från Naturvårdsverket ingå, eftersom Naturvårdsverket ger regler för tillstånd om sprängning i bergtäkter.

Länsstyrelserna utger tillstånden för bergtäkter, men tillämpar tyvärr inte Sprängstandarden SS 460 4866. På grund av klagomål från boende i omgivningen runt bergtäkter, så använder länsstyrelserna komfortvärden enligt standard SS 460 48 61.

Min uppfattning är att den nya Sprängstandarden SS 460 4866:2011 utgåva/edition 3 inte är tillämpbar i dagens läge. Därför föreslår jag att standarden SS 460 4866 version 2 från år 1991 istället ska tillämpas, tills någon ny version blir utfärdad av SIS Ag 3! □

Källa: Husbyggaren nr 3 B 2012

ABRAVIBE – A Toolbox for Teaching, Learning & Performing Vibration Analysis

Anders Brandt, University of Southern Denmark

ABSTRACT

This paper presents the ABRAVIBE toolbox for teaching, learning and performing vibration analysis. This free, open toolbox can also be used with the free open GNU Octave software, if an entirely free software platform is wanted, with a few functional limitations. The toolbox includes functionality for simulation of mechanical models as well as advanced analysis such as time series analysis, spectral analysis, frequency response and correlation function estimation, modal parameter extraction, and rotating machinery analysis (order tracking).

INTRODUCTION

This article presents a toolbox for MATLAB and GNU Octave which was developed as an accompanying toolbox for the book "Noise and Vibration Analysis – Signal Analysis and Experimental Procedures", [1]. In addition to the book and toolbox, a newly opened web site at www.abravibe.com offers additional help for teaching and learning vibration analysis, by providing additional toolbox examples, theory problems, videos, etc.

There are three main purposes with the ABRAVIBE toolbox:

1. to aid teachers in setting up realistic and illustrative examples of the many intriguing things in mechanical vibrations in general, and experimental vibration analysis, in particular,
2. to aid the student's understanding of mechanical vibrations and analysis procedures, by being able to go through each step in calculations etc., in an open fashion, and finally,
3. to be a tool for students, researchers, and engineers in industry, for analysis of vibrations in an open software environment. For this purpose, the toolbox includes functionality similar to a typical high-end commercial software system (except the data acquisition part), and many extra functions not usually available in commercial systems.

All these purposes are supported by many examples supplied with the toolbox, ordered into separate folders for each chapter of the book. The principle of the toolbox is to allow transparency for the student/user into all the steps in the analysis, so that every single step can be investigated to ensure understanding. The toolbox thus contains high-level commands for standard tasks needed in this field. And each and every function is open, so that the student can open it and investigate it.

All functionality can start with recorded or simulated time data, the latter being found by the author to often being easier to comprehend by students, if they themselves can go through all the typical steps of analysis such as converting data to spectra, then perhaps to frequency response functions, and thereafter for example extracting operating deflections shapes for animation. A teacher using the ABRAVIBE [2] toolbox can very easily set up examples to illustrate various aspects of vibrations and/or vibration analysis. In assignments, the teacher can also set up example scripts at a level so that the students can accomplish requested results in a reasonable time, for example in time limited lab assignments. Undergraduate students can thus get more "canned" demonstrations, whereas graduate students can be asked to develop more of the tasks themselves.

As an overview, the ABRAVIBE includes, among other things, functionality to

- store data with header information in a standardized format, which allows for easy implementation of, for example, operating deflection shape analysis and experimental modal analysis,
- import and export data in universal file format, to allow import from and export to most commercial measurement systems in this field,
- generate data in the form of frequency response functions (FRFs), or modal parameters, from known mechanical systems described by mass and stiffness matrices and either damping matrices, or modal damping,
- generate simulated time data for the forced response of mechanical systems, which can be used for understanding mechanical vibrations, as well as for investigating signal analysis techniques on data with known parameters,
- define signal analysis operations such as filtering, acoustic analysis (1/n octaves, sound level meter integration), etc.,

- compute statistical functions such as probability density functions, skewness and kurtosis, frame statistics and hypothesis tests for stationarity tests, and data quality assessment,
- estimate spectra of time signals by linear (rms) spectra, spectral densities, or transient spectra (energy spectral density), with time windowing, averaging etc. by the same algorithms implemented in commercial software, and some more sophisticated methods not yet available commercially,
- estimate frequency response functions and coherence functions, either from impact testing (using the enhanced method described in [1, 3]), or from shaker testing, with single-input as well as multiple-inputs,
- perform order tracking functions such as rpm maps, synchronous resampling, order maps etc.
- extract modal parameters using well-known modal analysis methods, simple SDOF as well as the time domain polyreference MDOF method, and
- animation of operating deflection shapes and modal analysis results. (Not available in GNU Octave.)

ABRAVIBE TOOLBOX EXAMPLES

In this Section we will look at a few illustrative examples of the use of the ABRAVIBE toolbox. These examples are suitable for anyone who wants to illustrate certain aspects of vibrations and the analysis of them.

Example 1. Time Domain Forced Response

A crucial part of teaching vibrations, is to illustrate the transient versus harmonic forced response, as well as the response to random loads. For vibration analysis, it is many times very important to be able to check an algorithm or method on data with known parameters. For all these purposes, the time domain forced response algorithm implemented in the toolbox, originally developed by Kjell Ahlin, is very important. The following example MATLAB code illustrates how a few lines of code can calculate the response of a single-degree-of-freedom (SDOF) system to a certain input force, in this case a half-sine pulse.

```
wn=2*pi*100; z=0.05; % Nat. frequency and damping ratio
m=1; k=m*wn^2; c=2*z*sqrt(m*k); % mech. parameters
```

```
T=11e-3;                              % Pulse time in seconds
fs=1e4;                               % Sampl. Freq. in Hz
t=(0:1/fs:.2)';                       % Time axis in column
F=makepulse(length(t),fs,T,'halfsine');
F=100*F/max(F);                       % Scaled force
u=timefresp(F,fs,m,c,k,1,1,'d');  % Transient response
```

Example 1. Code to generate time forced response of a SDOF system to a transient (half sine) force signal. The result is plotted in Fig. 1.

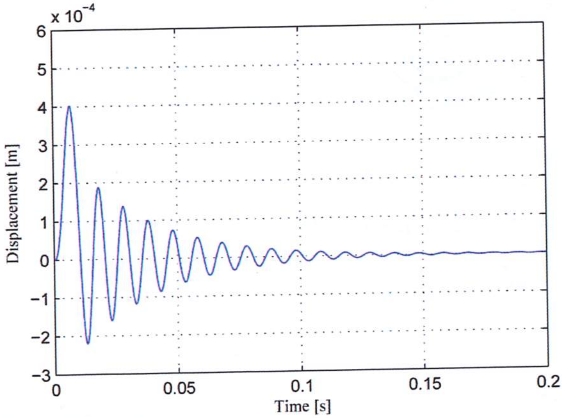


Fig 1. Plot for Example 1. SDOF response to a half-sine input force

Example 2. Spectral Analysis

Spectra are perhaps the most commonly used functions for vibration analysis. The ABRAVIBE toolbox therefore includes a number of high-level commands to produce spectra of multi-channel recorded or synthesized data with the same functionality as any FFT analysis system. There are many examples illustrating various details of spectral analysis in the chapter examples, for example how to optimize the spectral analysis FFT settings, such as the blocksize, for minimizing bias error etc. A special ABRAVIBE storage format contains header information such as type of data (time/spectrum etc.), x-axis increment, units of measurement, point number and direction etc. This ensures the toolbox can be used practically for larger measurements, such as for example in experimental modal analysis. The following code shows how to load a file with time data, compute a spectrum in the form of PSD, and plot the result including some header information.

```
load('ShipFile30')
fs=1/Header.xIncrement;
[P,f]=apsdw(Data,fs,4096); % Calculate PSD
```

Example 2. Toolbox code to load time data from a measurement, and compute a PSD. The result is plotted in Fig. 2.

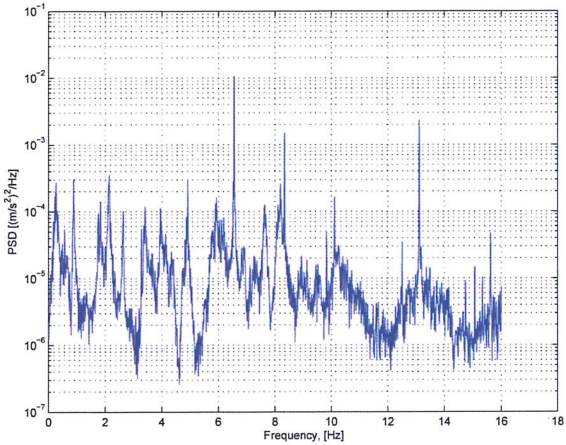
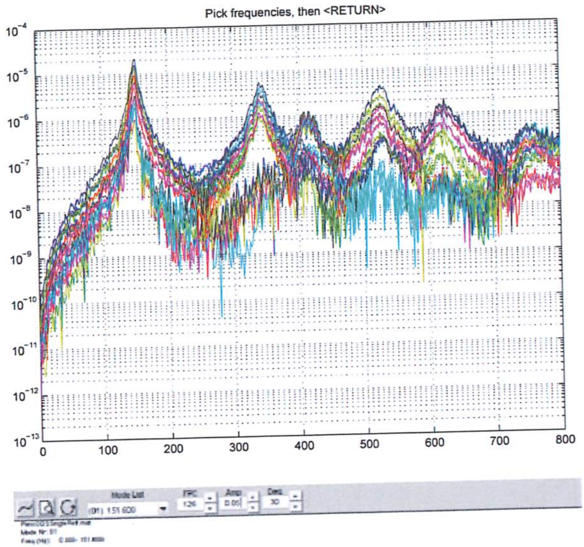


Fig 2. Power spectral density (PSD) plot from example 2.

Example 3. Operating Deflection Shapes (ODS)

ODS is today a common technique to aid the understanding of a vibration problem. The technique is based on finding the vibration amplitude and phase in each point on the test structure at a particular frequency; typically a frequency where there is a resonance-related vibration problem. At the blog belonging to the ABRAVIBE web site, at http://blog.abravibe.com, there is an example of how to perform an ODS analysis from measurements on a plate. The essential code lines are the following.



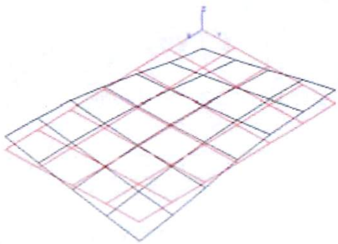


Fig 3. Plots for example 3, ODS. The top plot shows spectra displayed by the odspick command, in which the user can click on any peaks for which a shape is to be extracted. The right plot shows an animation of an ODS from the first peak in the spectrum plot.

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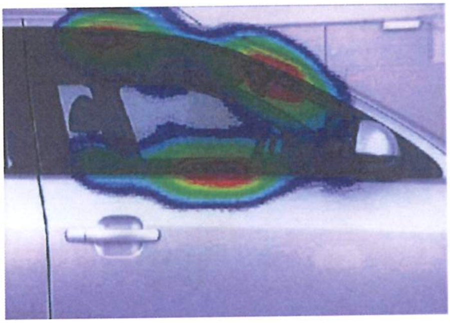
Acoutronic lanserar nu "**Acoustic Camera**" i Norden. Ett lätt och smidigt sätt att dokumentera och lokalisera ljudkällor. Tillämpningsområdena är många, och i samband med det gör **vi gärna konsultarbeten och projektarbeten**.
Hör av Er till Torbjörn Kloow



- Generera akustiska foton & filmer
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```
% Calculate Cross spectra
[Gxx, Gyx, Gyy,f]=time2xmtrx(RefSignal,y,fs,N);
Ref=1;     % Select reference point
% This produces a plot to select frequencies:
[O,ofreqs]=odspick(Gyx(:,:,Ref),f,5);
```

Example 3. Code to produce cross spectra and perform an ODS analysis. The plot produced by the **odspick** command and one resulting shape animation is shown in Fig. 3.

For more examples, the toolbox is supported by a web site at www.abravibe.com where the toolbox can be downloaded, and where numerous examples, problems, videos, and other resources for teaching and learning about vibrations and vibration analysis can be browsed.

REFERENCES

[1] Brandt, A., *Noise and Vibration analysis – Signal Analysis and Experimental Procedures*, John Wiley and Sons, 2011.

[2] Brandt, A., *ABRAVIBE, A MATLAB/Octave toolbox for Noise and Vibration Analysis and Teaching*, Revision 1.2, 2013, University of Southern Denmark. Available at http://www.abravibe.com.

Fleet Wide Asset Monitoring: Sensory Data to Signal Processing to Prognostics

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Abstract

Historically, prognostic application deployments appear in military applications. Recently, the power generation industry has shown strong interest in fleet wide condition monitoring and prognostics. These next generation fleet wide asset monitoring solutions are incorporating machine failure prediction and prognostics technologies. The technologies build on signal processing of vibration time waveforms, process parameters, and operating conditions of the machine. For prognostics algorithms to work well, the signal processing algorithms need to be applied correctly and the results need to be reliable. This paper introduces signal processing techniques as applied to specific machine components with a focus on the output and use with prognostics technologies. With properly organized outputs, prognostics algorithms transform the fleet condition and health management challenge into a deployable fleet health management solution.

To arrive at the deployable fleet management solution, a systematic approach in the design of the prognostics system is preferable. This approach includes data and model driven failure patterns, sensory data connectivity from deployed assets, prognostics analytical applications, and advisory generation outputs which guide the asset owners and maintainers. To illustrate the concepts, a fleet wide power generation asset monitoring case study is presented. In particular, the work described in this paper is developing and deploying a framework for condition monitoring and prognostics within the power generation industry. Currently, automatic condition indicators are being collected using cost effective vibration and temperature surveillance systems. A framework for prognostics is in design, along with deliverable components. The end goal of the project is to deliver a fleet wide asset monitoring enterprise framework for the power generation industry that includes asset condition surveillance and prognostics.

1. *Introduction*

As costs decline to collect sensory data from industrial assets, it is more practical than before to implement an asset health management system for critical and balance of plant assets. Sensory data is available from supervisory control systems, and from low cost embedded data acquisition systems supporting specialized surveillance such as vibration or electrical power monitoring. To transform this abundance of data into actionable scheduling and maintenance activities, a systematic approach in design and implementation of a prognostics solution is recommended (Lee, 2009).

There are several steps to consider when implementing a Fleet-wide asset monitoring or health management system, Figure 1. The first is to identify the assets within the fleet for which a business case exists that justifies the expense of gathering and analyzing sensory data, and advising operations and maintenance. There are many sources of business benefit including uptime impacts on revenue, safety of workers, productivity, or even improvements in asset design (Hollingshaus, 2011). In the case of power generation plants, assets selected for advanced monitoring and prognostics include circulator water feed pumps, coal pulverizes, gas turbines, steam turbines, generators, and transformers.

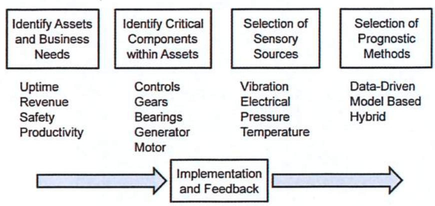


Figure 1: Four Steps in Design of Prognostics Systems

A second step in the design and implementation of a fleet-wide health management system is selection of critical components within an asset class that impact the ability of the asset to perform its function to acceptable standards. A typical methodology is the Failure Mode and Effects Analysis (FMEA) and Failure Modes, Effects, and Criticality Analysis (FMECA). In several industries, the process is formalized and includes published standards (Reliability 2004).

The third step in the implementation process is sensor selection. Sensor selection builds on selected asset component, expected failure and degradation modes, and availability of proven sensory data interpretation algorithms. Selection of sensors and sensory data is impacted by availability of built-in sensor data from existing systems, cost of additional sensors and installation, and impact of data storage requirements. Further, some experimentation may be necessary to fully determine whether specific sensory data and analytics lead to information that is useful in predicting machinery component failure (Lei, 2004).

A fourth step in the implementation process is selection of the prognostic method for the asset class and business environment. Data driven methods require historical operational data to use as comparison using statistics and probability functions to derive estimates and predictions of health and reliability for a given asset. (CALCE, 2012), (NASA, 2012). Even if failure data patterns are not available, data driven methods can be used to compare current machinery surveillance data with historical normal operation. Any deviation from the normal, can be considered an anomaly and worthy of additional study by subject matter experts. Given a degradation is detected; a new pattern can be added to the collection of fault signatures for future use.

Physics driven prognostics often involve a model, or accepted standards for surveillance monitoring outputs. The Physics-of-failure (PoF) approach relies on knowledge of the assets' life cycle and the impact of loading, operational conditions, geometry, materials, and failure mechanisms. For example, there are a number of standards for interpretation of vibration signatures including acceptable vibration levels for specific machine components and classes of assets. A bearing vibration analysis incorporates geometries of the bearing, speed of the machine (operational condition), loading, alignment of the shaft, and perhaps the L10 design life of the bearing. And of course, both data drive and physics driven methods can be combined to form a hybrid approach to fleet-wide asset monitoring applications.

Finally, most fleet-wide implementations begin with a selected few assets in the fleet. With an initial deployment step, costs can be contained and the deployment strategy validated. Many questions or challenges are investigated during this pilot phase of implementation. These include the ability to make sensory measurements under consistent conditions, ability to reduce sensory data using embedded computations, and the ability of analytics on collected and historical data to predict patterns and rates of degradation.

2. *Six Classes of Machines and Assets*

There are many parameters to evaluate in determining whether a collection of assets deserve monitoring for degradation and automatic processing of degradation indicators. It is up to the owning organization to determine whether financial, safety, or environmental merits exists to justify an expense of condition monitoring and prognostics. The FMECA methodology mentioned earlier serves as a model for making these evaluations. Given merits for monitoring and prognostics, it is desirable classify the asset and identify critical components within the asset family.

There are many types of machines and assets. Assets can often be grouped into a class of machinery with similar condition monitoring techniques, sensory uses, and recommended condition monitoring practices. In beginning the implementation process, it is useful to categorize the assets into one of the following classes, Figure 2.

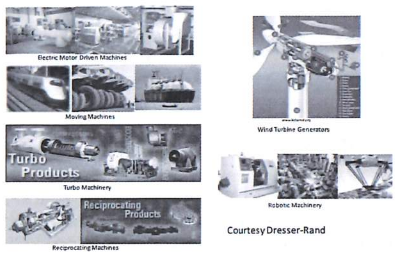


Figure 2: Six common classes of machines

For each class of machine, there are specific commercial and experimental techniques for condition monitoring that offer methods for predicting mechanical and functional degradation.

For example, motor driven machines may incorporate electrical power sensors and signature analysis. Moving machines may require special load and speed sensors to organize sensory data into operational cycles. Each class of machine brings with it a traditional approach of condition based maintenance and specific and accepted sensors and signal processing techniques.

Within each asset, there are multiple critical components common to mechanical function of the machine. In rotating machinery for example, several component failure modes are common, Figure 3.

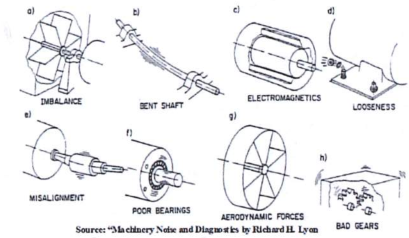


Figure 3: Common Mechanical Failure Sources

With understanding of the asset type within the fleet, it is prudent to identify the key components whose failure directly or significantly impacts the function of the asset. The classes of assets and common mechanical failures are widely used categories for breaking down the asset monitoring and prognostics problem in rotating machinery.

Since most industrial assets have rotating components, it is appropriate to consider common sensors and analytics used to derive parameters that can indicate machinery degradation and failure.

3. *Sensor Selection and Analytics*

There are many sensors available for monitoring and control of machinery assets. Many exist in the machine as a control related sensor, while others are added to the industrial asset for performance or mechanical health indicators. Common sensor types are shown in Table 1.

Sensor	Graphic	Use
Temperature		Heat as friction indication
Flow		Flow of fluids or gas
Speed		Rotational speed
Acceleration		Vibration
Displacement		Shaft movement
Pressure		Pressure (cylinder)
Electrical Power		Motor Current / Machine Load

Table 1: Common Sensors Used For Asset Monitoring

Other sensory information reported from the control system may include error codes, torque, cycle step, and so on. These control system parameters are often useful in correlating the machine's operating condition with measurements from common sensors in Table 1. It is important to sort measurements into operating modes or regimes to improve correlation of on-line measurements to historical data patterns.

Analysis of sensory data allows the fleet asset monitoring system to transform data into information useful in determining amount and pace of degradation, and therefore in predicting a failure of the asset to perform its intended function. The output of analysis algorithms reduces the raw sensory data into features which describe the original measurement. These features or descriptors are the numeric inputs which prognostic algorithms use to perform association of an asset's current state of health with historical machine health patterns, or models of machinery health. Figure 4 offers several analytic techniques and the feature results these analysis techniques may produce.

In Figure 4, the top row lists a series of time series trend analysis that yield averages, rates of change, and current values. The second row lists several statistical measures of a time series vector or trend which indicate shape and distribution of a series of sequential measurements from a single sensor. In the case of a roller bearing, frequency analysis of a high sample rate vibration snapshot can reduce the sensory data to characteristic fault frequency amplitudes indicative of defects in the roller bearing. An advanced analytical technique, wavelet analysis, reduces a high sample rate snapshot from a dynamic sensor to wavelet packet coefficients which indicate presence of transient phenomenon in the measured signals. Transients may be indicative of impacts in the case of a roller bearing, pulsation anomalies in the case of flow or pressure, and so forth.

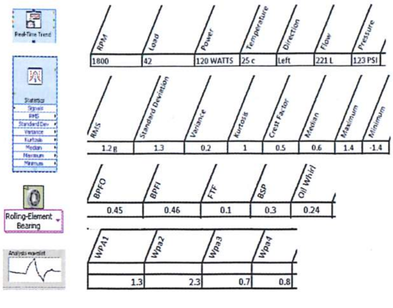


Figure 4: Analysis with Feature and Results

Knowing that vibration sensors are common sensory measurements used in rotating machinery applications, we may consider taking a closer look at frequency analysis of vibration signatures recorded by accelerometer or displacement probe sensors. Figure 5, depicts the Fast Fourier Transform (FFT) of a vibration sensor signature from the bearing on the input side of a gearbox.

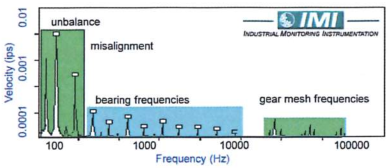


Figure 5: Fault Frequencies of Machine Vibration

Using the results of the FFT, analytically it is typical to measure amplitudes shown in Figure 5 as Velocity in inches per second (IPS) and compare the amplitude for specific fault modes to historical norms, or to vibration severity standards such as the ISO 10816. When the amplitudes of specific vibration frequencies exceed historical norms, or a standard recommended warning level, the machine component where the vibration sensor is located is considered degraded to the extent its vibration level has exceeded the historical norm or standard warning level.

However, depending on the indicative features of interest, there are a number of signal processing algorithms used to alternatively or subsequently analyze the time waveform or the results of the FFT. Some of these are listed in Table 3. Advanced analytics build on the FFT, creating additional numerical features and augment the degradation status of the machine.

Signal Characteristic	Analysis Methods	Machine Example
Narrow frequency band lasting for a long time	• Frequency Analysis • Fast Fourier Transform • Power Spectrum	Unbalance in a single speed machine
Narrow frequency band with harmonics lasting for a long time	• Quefrency • Cepstrum	Damaged bearing in a machine with roller element bearings
Time varying frequency band	• Time-frequency analysis • Order analysis	Unbalance in a variable speed pump
Wide frequency band signal lasting for a short time	• Wavelet analysis • AR Modeling	Low speed machine with compressor valve impacts
Narrow frequency band signal lasting for a short time	• Wavelet Analysis	Electrical motor driven machine with rub and knock noise.

Table 3: Signal Processing for Dynamic Sensors

Specific use cases of advanced signal processing include time synchronous averaging (TSA) to isolate non-synchronous signals from synchronous signals. Additional advanced techniques include Cepstrum which is a frequency type analysis of the FFT (Zhang, 2008). Wavelets and order analysis are additional examples. Each of these advanced signal processing techniques works to clarify specific features found in the original FFT, by removing or isolating those specific dynamic signal amplitudes that best indicate the asset component's degradation trend or pattern.

4. PROGNOSTIC METHOD SELECTION

There are two general methods of prognostics applications; data driven and model based (Sankavaram, 2009). Data driven methods work best with historical data sets indicating common failure and normal operation of the entire asset as well as its individual components. Model driven methods use mathematical models to describe the relationship between measurements and expected asset behaviour.

With data driven methods, historical data is pre-processed to reduce the sensory data to a set of calculated features that describe the normal and various failure conditions. Once this reduction is complete, the data-driven model then relies on one or more health assessment algorithms. These health assessment algorithms work to evaluate the fit of current measurement data to the normal and failure condition feature sets. Example health assessment algorithms include logistic regression, statistical pattern matching, Hidden Markov Models, and Gaussian mixture models.

With model driven methods, a system model is derived from first principle analysis and simulations. Measured data and features, along with system state variables become inputs to the model equation where the outputs map to normal operation or a failure condition. To adapt to specific machinery or operation conditions, often an adaptive learning or model update process is required. The model is derived from system physics and expected behaviour. The model then serves as a reference to normal and various failure conditions. Health assessment algorithms then work to fit current measurements to model outputs under similar operating conditions.

As a comparison, data driven methods often require run-to failure data which may be expensive or impractical to obtain. Model driven methods require accurate modelling and the ability to execute and tune the model in real-time leading. Developing models can be expensive from an engineering perspective. Executing models in real-time as measured data arrives may require extensive computational resources.

Often, a combination of approaches is desirable. Test cell data from design verification testing or factory acceptance testing can provide normal behaviour data sets. Many mechanical components have accepted limits on calculated features such as vibration severity levels for which a simplified model can be inferred. By combining data driven, and macro model driven approaches, a basic automated degradation detection and trending system becomes possible.

5. PILOT IMPLEMENTATION WITHIN A FLEET (CASE STUDY):

A power generation plant is heavily data driven. Machine controls continuously report process information to the plant historian, often an OSIsoft, Inc. PI System™ historian. The historian stores and manages a large amount of process data that is acquired at rates up to 100 times per second (100 Hz). Because of the significant amount of process data in place, and the approved budget to add vibration sensors, a data-driven prognostics model may be appropriate. In addition, many power generation plants also use anomaly detection software which automatically scans historical data in the plant historian. Available anomaly detection software products include Instep Software's PRiSM, General Electric's SmartSignal, and IBM's software SPSS. These tools build data-driven models from process data which are used to detect anomalies or deviation from normal behavior. Finally, some physics of failure information derived from the design of bearings and gears is readily available in literature. Based on bearing and gear geometries, vibration frequencies indicating degradation, so called "fault frequencies" are also well defined in literature, With historical process data, the ability to store and manage additional data, anomaly detection, and basic vibration models in hand, a hybrid of data-driven and model-based prognostics is selected.

5.1. Data Acquisition System Overview

To supplement process data, the power generation plants are adding vibration sensors to bearings and gears within the pumping systems. As piezoelectric acceleration sensing technology is an established technology, vibration sensors are more economical today. In addition, many vibration sensors are available with a temperature sensing element on-board, yielding a dual measurement: acceleration and temperature. Rugged data acquisition systems, with wireless communications, can be placed in close proximity to pumping systems and thus allow cabling distances to be shortened, further lowering the cost of installation. In summary, it is less expensive to install permanent sensors with wirelessly networked logging than to employ workers with hand held recorders, considering safety risks associated with making measurements. A diagram of the vibration and temperature data acquisition system is shown in Figure 6.

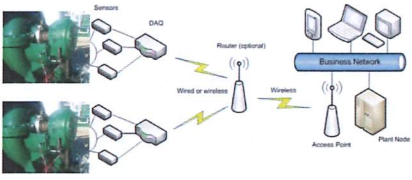


Figure 6: Automatic Data Acquisition Architecture

Currently, Duke Energy has installed over 3000 sensors with over 300 automatic data acquisition and logging devices (Cook, 2012). These sensor and data acquisition systems are co-located with the equipment and often connected to the business network using standard wireless 802.11g networking. Vibration and temperature data is logged selectively, transferred to a plant data aggregation computer, and using OPC communications to upload vibration feature calculations into the plant historian.

Taking a closer look at the systems architecture, there are two areas of computation, Figure 7. These include the smart data logging field device, and plant computing infrastructure. This architecture represents a basic prognostics system in industrial settings (Lei, 2004).

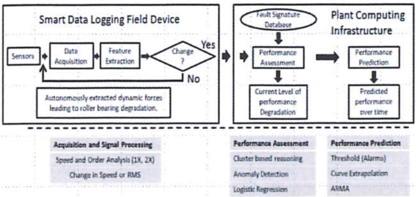


Figure 7: Monitoring and Prognostics System Architecture

By monitoring FFT amplitudes for changes, the data logging device is intelligent about the data it logs to its local disk. Changes in measured value, calculated feature, changes in time, or even a logging demand from a remote user can trigger a recording within the smart logging device.

When the trigger condition is met, a local file is opened and data recording occurs until the configured length (in time) of data is recorded. Once the prescribed time duration of data is recorded, the plant node computer (Information Technology (IT) infrastructure) is notified of an available data file on the data acquisition device.

This recording architecture has two advantages. First, by recording data locally, a store and forward implantation is met. This allows recordings to be made whether or not a communications network is available. Second, by evaluating the sensor data for trigger conditions, the amount of data transferred to the plant node computer is minimized to just that data which has new information. In other words, if the sensory data does not change, a recording is not made.

To allow for fleet wide comparisons and analysis, all data recordings down to the sensor level are labeled with equipment hierarchy, as well as description including make and model of the individual component, Figure 8. With the hierarchy in place, it is possible to find and compare vibration sensors and extracted features from like bearings in like machines within the same plant or across multiple plants. By utilizing equipment hierarchy, it becomes possible to develop comparisons between plants as well as to contribute to and enhance a fault signature database. This hierarchy enables subject matter experts, familiar with the machines, to investigate specific machines and retrieve both raw and processed data from sensors at the specific machine. Further, when the hierarchy is the same as used in the control system, process values can be correlated with the data recordings made by the smart data logging device. Correlated process values can include fluid flows, power generation load, ambient temperature, and so on.

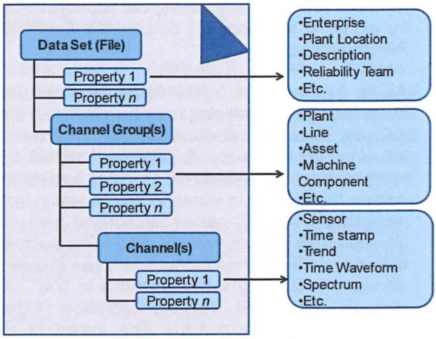


Figure 8: Descriptive Information in the Recording.

To summarize, the data acquisition portion of the asset monitoring and prognostics application is designed to record sensor data when the data or calculated features from the data has changed. Calculated features include leading indicators of bearing and gear degradation. These calculated features are also logged along with the original vibration time waveforms. The recorded data files are retrieved by the plant node computing or IT computing infrastructure. With equipment hierarchy metadata labeling, sensory data and feature calculations as well as descriptive metadata, the plant node IT computing infrastructure has a complete set of information for trending and diagnostics.

5.2. Plant Computing Analytics

As data arrives on the plant node computer and enters the IT computing infrastructure, it is stored and indexed for retrieval using metadata tags. Further, the extracted features and calculations made within the data acquisition nodes are made available to the plant historian. The plant historian subscribes to those signal features useful for statistical trending and anomaly detection. Subscribed features include overall vibration levels, and degradation inducing forces which are first and second vibration harmonics of running speed. Once stored and indexed, typical retrieval of raw time waveform data is performed by subject matter experts for diagnostic purposes.

The real power in this asset monitoring and prognostics application is the use of the plant historian for developing data driven models that include process data, as well as newly added vibration and temperature sensor data. Using subscriptions, the plant historian records features and values for off-line data driven model development. In many cases, the application tool for modeling and anomaly detection is the Instep PRiSM product.

As an example, the intake filters for circulating water feed pumps will clog from time to time. This clogging causes cavitations at the pump vanes, inducing high frequency vibration on the shaft and roller bearings. The smart data logging field device detects the change in vibration and makes a local recording. The IT server is notified and the vibration data records are retrieved. The anomaly detection software then recognizes a rise in overall vibration level along with reduced fluid flow. An alert is forwarded to the vibration expert responsible for the pump. The expert is not physically located at the plant, yet is able to use his virtual private network (VPN) remote access ability to log into the plant node computer where the recorded vibration and temperature data resides. With the drill down equipment hierarchy tree view of equipment within the plant, the vibration expert is able to quickly find the specific pump, and review waterfall spectrum. Knowing that filter clogs induce cavitations and high frequency vibrations on the shaft, he confirms the likelihood of filter clog issue with the recent occurrence of high frequency vibration in the spectrum. Without having to spend an entire day traveling to the site to use portable diagnostic instruments, he is able to create a work order to clean the water intake filters. As a result, the problem is solved a day sooner and the domain expert is freed to spend the same day reviewing other reported anomalies.

The anomaly detection software works by developing and using data driven prognostic models. By using all available data about a given asset or mechanical component, the Instep PRiSM tool develops a series of normal operation profiles for a particular instance of the equipment type. The normal operational profiles include temperature, process values, as well as the vibration measures reported by the rugged data logging devices. Further, several normal operational profiles are created, one for each operating regime such as high load or low load. Finally, the normal profiles are normalized across similar equipment and operational profiles (Billingsly, 2009).

The Instep PRiSM software uses pattern matching algorithms such as statistical pattern matching to compare normal operations models with machinery data recordings that are not normal. An example of statistical pattern recognition is shown in Figure 9.

Figure 9: Sample Statistical Pattern Matching

In case studies provided by Instep Software, PRiSM learns normal behavior patterns in about two months, after installation and configurations. The pattern development is performed in an unsupervised manner. While Instep's PRiSM is a promising software technology with a broad reach to any data within the plant historian, there remain additional options for prognostics and diagnostics. These include the development of specific fault signatures, or faulty behavior models. With supervised learning, the pattern recognition algorithms can be trained to recognize deviations from normal operation that match a specific fault signature. With fault signatures in hand, additional diagnostic advisories become available to supplement anomaly alert. The advisories then help the maintenance team arrive at the machine with the right tools and equipment to take immediate action and speed the diagnostic investigation process.

At Duke Energy, the asset monitoring and diagnostics application is just getting underway. Many of the machines have been outfitted with vibration and temperature sensors, and smart data recording devices. Data flows from the data recording device along with metadata and extracted or calculated features. Once the data and calculated features reach the plant node computer, vibration and temperature features are posted for subscription by the plant server. Anomaly detection software, including PRiSM software, is being trained to alert plant personnel of deviations from expected machine or pumping system health and performance.

6. CONCLUSION

The implementation of a fleet wide asset monitoring and prognostic systems combine several disciplines. These range from traditional condition based maintenance practices, to development of data-driven fault models, to implementation of hybrid prognostic systems. There are potentially many benefits derived from a systematically developed prognostic system. These benefits promise to pay dividends to electrical power generation and other industries that employ many mechanical assets of similar types and function.

Similar pilots are occurring in the Oil and Gas industry for land based drilling and extraction equipment. Other pilots are just beginning in mining industries, centered on haul trucks, swing shovels, and drag lines. These pilots are similarly challenged by the cost of sensors and data acquisition hardware, cost effective analysis, cost effective data storage, and the development of data driven and physics of failure fault signatures. Despite these challenges, significant work has been accomplished in the areas of remote monitoring, diagnostics, and prognostics. These works serve as recipes for success in power generation and similar process industries.

7. REFERENCES

Lee, J., Chen, Y., Al-Atat, H., Abuali, M. and Lapira, E. (2009). A systematic approach for predictive maintenance service design: methodology and applications. *International Journal of Internet manufacturing and Services*, Vol. 2, No. 1, pp. 76-94, 2009.

Hollingshaus, B. (2011). Program 69: Maintenance Management and Technology. *Electrical Power Research Institute Descriptions of Past Research.* Catalog number 1022681, May. 2011 www.epri.com

Reliability Hotwire (2004), Reliability Basics, *Reliability HotWire,* Issue 46, December 2004, http://www.weibull.com/hotwire/issue46/relbasics46.htm

Lei, Y., Djurdjanovic, D., Workman, G., Xiao, G. and Lee, J. (2004) Basic prognostics in industrial automation systems., *Proceedings of the 6th International Conference on Frontiers of Design and Manufacturing.* June 21-23, Xi'an, China, 2004

Center for Advanced Life Cycle Engineering (CALCE), University of Maryland (2012). Introduction http://www.prognostics.umd.edu/tutorials.htm

National Aerospace and Space Administration (NASA), (2012). Data-Driven Prognostics http://ti.arc.nasa.gov/tech/dash/pcoe/data-driven-prognostics

Zhang, N. (2008) Advanced Signal Processing Algorithms and Architectures for Sound and Vibration. *National Instruments NI-Week Conference*. Presentation TS 1577. August 4-8, Austin, Texas

Sankavaram, C., Pattipati, B., Kodali, A., Pattipati, K., Azam, M., Kumar, S., and Pecht, M. (2009), Model-based and Data-driven Prognosis of Automotive and Electronic Systems. *Proceedings of 5th Annual IEEE Conference on Automation Science and Engineering.*, August 22-25, Bangalore, India http://www.prognostics.umd.edu/calcepapers/09_ChaitanyaSankavaram_prgnosis_automativeElecsystems.pdf

Cook, B. "Smart monitoring and diagnostics for power generation" National Instruments NIWeek conference, August 7-9, Austin, Texas, 2012

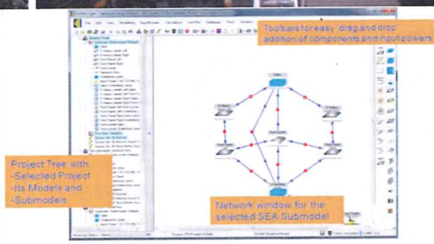
Billingsly, L. "Reducing Downtime and Manhours", M2M Magazine, http://www.instepsoftware.com/pdf/Exelon_Case-Study.pdf, October, USA, 2009

Våra annonsörer

Gothenburg Sound AB är ett litet företag med anor från 60-talet

Gothenburg Sound AB är ett litet och personligt företag som huvudsakligen arbetar med professionell ljudinspelning , redigering och mastering. Vi kan även redigera dina videoklipp och producera högkvalitativa ljudspår för dem. Dessutom säljer vi utrustning och programvara inom vårt område av expertis inklusive egen design och kundanpassade produkter för kunder.

GSAB grundades 1966 och vi har en stor erfarenhet av både digital och analog inspelnings- och masteringteknik. Det hela började då vi var en del av 60-talsgruppen the Beachers från Göteborg och satte upp en liten inspelningsstudio för att främst ta fram egna och andra grupers demoband. Studioverksamheten var som störst på 80- och 90-talet med två studios.



Idag är det två aktiva pensionärer som är verksamma, Urmas Plunt driver ljudinspelningar och service på analog ljudutrustning och Juha Plunt utvecklar programvara för Statistisk Energianalys (SEA).

Med vår långa erfarenhet, har vi en unik kompetens att reparera och renovera äldre analog ljud- och studioutrustning, högtalaranläggningar och orkesterutrustning. Vi har också några sällsynta reservdelar till äldre professionell utrustning .

Vi utvecklar programvara för ljud-och vibrationsprediktering med Statistisk Energy-analys (SEA) sedan mitten av 1980 - talet. Den var ursprungligen baserad på Juha Plunts forskningarbete på 1970-talet vid Chalmers tekniska högskola och har succesivt utvecklats till den nuvarande GSSEA-Light programvaran för Windows. Det torde vara det enda någorlunda omfattande SEA-programvaran till "budget"-pris genom att bland annat 3D-modellering inte implementerats, och därmed tillgängligt även för mindre och medelstora företag.

NOVEM 2015

Noise and Vibration Emerging Methods

Dubrovnik, Croatia, April 13-15, 2015

scope

NOVEM 2015 is the 5th conference in the series. It is aimed at promoting scientific exchange between specialists. The goal of the conference is to give an account of emerging technologies in selected areas considered to be the major challenges in the fields of:

- structural vibration
- vibro-acoustics
- flow-induced noise & vibration
- noise and vibration control

programme

In addition to contributed papers a 2-hours long Keynote Forum will be held each day. The Forums will enable selected specialists to expose an up-to-date overview of the relevant area and outline its perspectives.

The NOVEM 2015 keynote areas are:

- novel modelling approaches
- advanced materials for sound and vibration applications
- innovative experimental techniques

venue

NOVEM 2015 will be held in the Excelsior 5* hotel in Dubrovnik, Croatia. The town is a medieval fortress on the Adriatic Sea, a UNESCO world heritage site. Dubrovnik International Airport is 22 km away from the old town centre.

deadlines

abstracts	17 Oct. 2014
abstract acceptance	21 Nov. 2014
full papers due	17 Jan. 2015
paper acceptance	13 Feb. 2015
early registration	20 Feb. 2015

organisation

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2014:

IMAC-XXXII
http://sem.org/CONF-IMAC-TOP.asp February 2-5, 2014, Orlando, Florida

Rail Technology Conferences 2014, Noise and Vibration
http://www.railtechnologyconferences.com/ 19 March 2014, Düsseldorf, Germany

SVIB Vibration days 2014 www.svib.se/ 3 April 2014, Denmark

2014 Torsional Vibration Symposium
http://torsional-vibration-symposium.com/ 21-23 May 2014, Salzburg, Austria

Baltic - Nordic Acoustic Meeting, BNAM 2014
https://www.euracoustics.org/eaa-societies/partner-societies/nordic-acoustics-association/bnam-2014 2-4 June 2014, Tallinn, Estonia

9th International Conference on Structural Dynamics, EURODYN 2014
http://www.fe.up.pt/eurodyn2014 30 June-2July, 2014, Porto Portugal

11th Intl Conference on Vibration Measurements by laser and noncontact techniques
http://www.aivela.org/11th_Conference/index.html 24-27 June 2014. Ancona, Italy

8th International Styrian Noise, Vibration & Harshness Congress
www.isnvh.cats-host.com/ 02-04 July 2014, Graz, Austria

21st International Congress on Sound and Vibration (ICSV21)
http://www.icsv21.org/ 6-10 July 2014, Beijing, China

ICNVE 2014 : International Conference on Noise and Vibration Engineering
http://www.waset.org/conference/2014/08/athens/ICNVE August 3 - 4, 2014, Athens Greece

12 Int. Conf. on Motion and Vibration Control (MOVIC 2014)
www.jsme.or.jp/conference/MOVIC2014/ 4-6 August, 2014 in Sapporo, Japan

ASME 26th Conference on Mechanical Vibration and Nois
http://www.asmeconferences.org/ idetc2014/CallForPapersDetail.cfm August17-20, 2014. Buffalo, New York, USA

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Forum Acusticum 2014
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Noise-Con 2014
http://www.inceusa.org/nc14/ 08 -10 September 2014, Fort Lauderdale, USA

ISMA Int Conference on Noise and Vibration Engineering 2014
www.isma-isaac.be 15-17 September 2014, Leuven, Belgium

Int Conference on Uncertainty in Structural Dynamics 2014.
www.isma-isaac.be 15-17 September 2014, Leuven, Belgium

16th Int Conf on Low Frequency Noise and Vibration and its Control
http://www.lowfrequency2014.org 29 Sept - 1 Oct 2014, Berlin, Germany

Internoise 2014
http://www.internoise2014.org 16 - 19 November 2014, Melbourne, Australia

2015:

IMAC-XXXIII Conference & Exposition on Structural Dynamics February 2-5, Orlando, Florida

Euronoise 2015
https://www.euracoustics.org/events/events-2015 31 May - 3 June, Maastricht, Netherlands

SAE 2015 Noise and Vibration Conference and Exhibition
http://www.sae.org/events/automotive/ June 22-25, Grand Rapids, Michigan, USA

22nd International Congress on Sound and Vibration (ICSV 22)
http://www.iiav.org 12 - 16 July, Brescia, Italy

INTER-NOISE 2015
http://internoise2015.com/ 9 - 12 August, San Francisco, USA

2016:

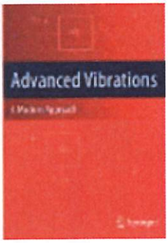
Euronoise 2015
https://www.euracoustics.org/events/events-2015 31 May - 3 June, Maastricht, Netherlands

23rd International Congress on Sound and Vibration (ICSV 23)
http://www.iiav.org 10 - 14 July, Athens, Greece

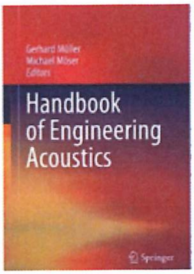
Ny Litteratur

Ett urval av nyutkommen litteratur av intresse

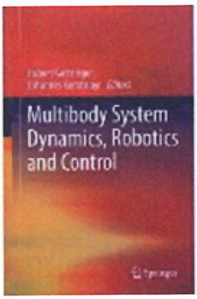
Nils Otto Myklestad: Fundamentals Of Vibration Analysis. Literary Licensing, LLC (July 28, 2012)



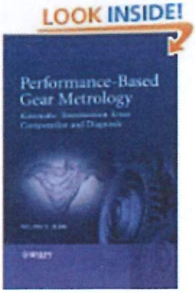
Reza N. Jazar: Advanced Vibrations: A Modern Approach. Publication Date: July 24, 2012



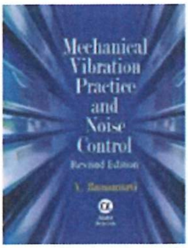
Gerhard Müller and Michael Möser: Handbook of Engineering Acoustics. Publication Date: November 28, 2012



Hubert Gattringer (Editor), Johannes Gerstmayr (Editor): Multibody System Dynamics, Robotics and Control. Springer; 2013 edition (December 31, 2012)

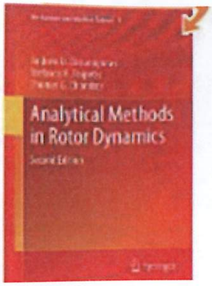


William D. Mark: Performance-Based Gear Metrology: Kinematic - Transmission - Error Computation and Diagnosis. Wiley; 2 edition (December 17, 2012).

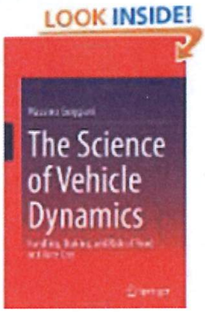


V. Ramamurti: Mechanical Vibration Practice and Noise Control, Alpha Science Intl Ltd; Revised edition (November 30, 2012)

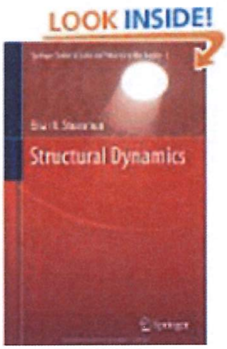
Colin Hansen (Author), Scott Snyder (Author), Laura Brooks (Author), Danielle Moreau (Author): Active Control of Noise and Vibration. Crc Pr I Llc; 2 edition (November 28, 2012)



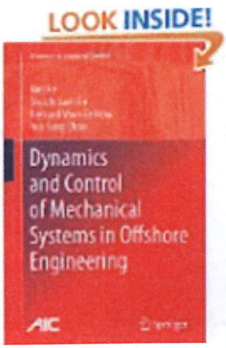
Andrew D. Dimarogonas, Stefanos A. Paipetis and Thomas G. Chondros: Analytical Methods in Rotor Dynamics. Springer; 2013 edition (February 19, 2013)



Guiggiani M: The Science of Vehicle Dynamics: Handling, Braking, and Ride of Road and Race Cars. Springer (January 22, 2014)



Einar N Strommen: Structural Dynamics. Springer (October 15, 2013)



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Frågorna inom industrin kring hur produkters prestanda och hållbarhet påverkas av den miljö de befinner sig i är många. Ämnet miljötålighetsteknik försöker ge svar på dessa. Metoderna för att finna svaren kan ofta innefatta analys, provning eller beräkning.

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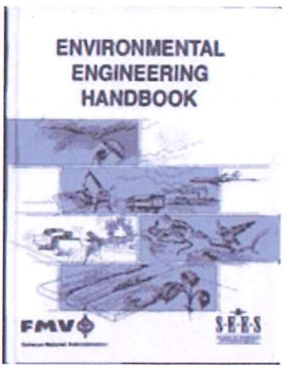
Beställning görs hos Helen Schneider, 08-782 08 08 eller via SEES hemsida www.sees.se



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Kursen äger rum den 15 maj 2014, kl 09.00 – 16.45 hos Teknikföretagen, Storgatan 5, Stockholm. Kostnad för kursen är 5 500 SEK för anställda vid företag som är medlemmar i SEES och 7 000 SEK för övriga. I kursavgiften ingår kurslitteraturen och en kurspärm innehållande kopior av de olika föredragens OH-bilder samt lunch och kaffe.

Anmälan är bindande och görs **senast den 2 maj 2014.**

Som föreläsare medverkar ingenjörer och forskare från SP – Sveriges Tekniska Forskningsinstitut, med mångårig erfarenhet inom ämnet. Planerade föreläsare är Gunnar Kjell, Magnus Palm, Mattias Viktorsson samt Bengt Andersson.

Frågor om kursen bevaras av Gunnar Kjell, 010-516 52 23 (innehållet) eller av Helen Schneider 08-782 08 08 (praktiska frågor).

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