ROTOR DYNAMICS & BEARINGS *(Nov 11-14, 2024)*

Venue: Maritim Hotel, Frankfurt (Germany) and ONLINE at the same time

ROTOR DYNAMICS & BEARINGS TECHNOLOGIES

Lateral & Torsional Vibration Analysis / Fluid-Film Bearings

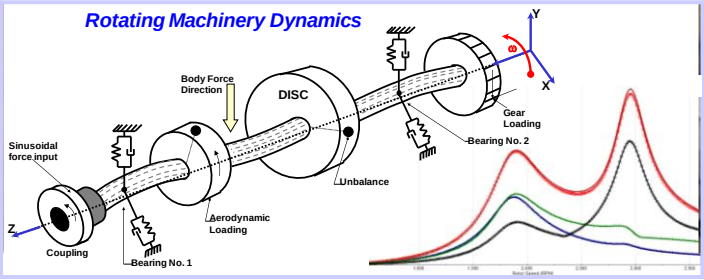
Basics & Theory / Practical Applications & Case Studies

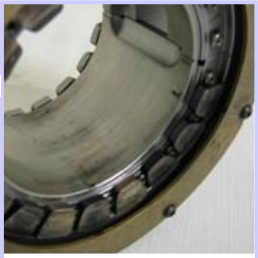
This international seminar is more than a short course – It is a real **TECHNOLOGY TRANSFER SEMINAR** performed by acknowledged experts tailored to engineers and technical managers involved in **ROTATING MACHINERY** design, operation, maintenance, diagnosis, and troubleshooting, with emphasis on machinery **rotor dynamics**, drive train **torsional vibrations**, and **fluid-film bearing systems** that support, guide, and locate the rotating assembly. Detailed coverage of all these topics includes the presentation of case histories and the application of advanced software for modeling, analyses, and troubleshooting real-life bearing systems and vibration problems encountered in rotating equipment. *No previous experience is required.*

1st Day:	Nov 11, 2024	***Hybrid Seminar*** **"FLUID-FILM BEARINGS"** *(Technology & Applications)*
2nd Day:	Nov 12, 2024	***Hybrid Seminar*** **"ROTOR DYNAMICS, Part 1"** *(Basics & Technology)*
3rd Day:	Nov 13, 2024	***Hybrid Seminar*** **"ROTOR DYNAMICS, Part 2"** *(Applications & Case Studies)*
4th Day:	Nov 14, 2024	***Hybrid Seminar*** **"TORSIONAL VIBRATIONS"** *(Basics & Applications)*
4th Day:	Nov 14, 2024	***On-site Seminar*** **"SPECIAL SOFTWARE APPLICATIONS"** *(Seminar & Workshop including LIVE Software Presentations)*

VENUE + DURATION: **MARITIM HOTEL, FRANKFURT (GERMANY) or ONLINE**
8 hours per day with breaks

Failure Due To Excessive Vibration




Journal/Thrust Bearings

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Internet: www.conceptsnrec.com

Presented by:

RBTS, Inc.

1041 West Bridge Street, Phoenixville, PA 19460, U.S.A.
Internet: www.rbts.com

About the Course

The main subjects of this course (4 seminars) are related to dynamic effects (vibrations) that occur in all rotating machinery (like turbomachinery, compressors, pumps, etc.):

- **ROTOR DYNAMICS** (lateral vibrations)
- **FLUID-FILM BEARINGS**
- **TORSIONAL VIBRATIONS**

The course prepared and conducted by professional experts and is designed for engineers and technical managers who are involved in rotating machinery design, operation, maintenance, diagnosis, condition monitoring, and troubleshooting, with emphasis on vibration analysis including the influence of bearings that support, guide, and locate the rotating assembly. The main objective of the course is to present details and methods to **properly understand the dynamic effects and vibration behavior of overall systems**. Participants are encouraged to present problems to be discussed. Since seminar time is limited, please send us your individual examples at least 1 week before the course starts and we will see how we can incorporate "your" topics (at least partially) into the course program.

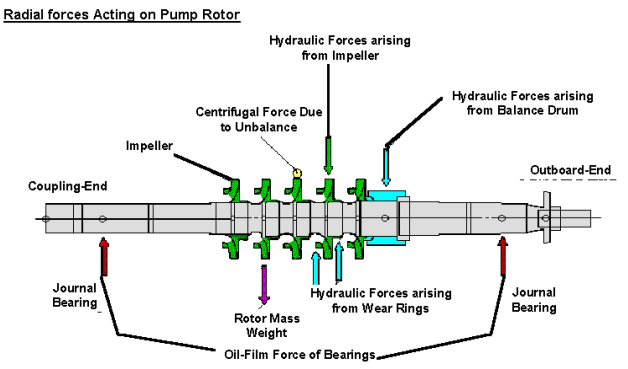
To cover all the specific topics of this seminar, the course has been divided into **4 coordinated seminars**, which can be booked completely – what we recommend – but also individually as single seminars.

Seminar #1 (Day 1) – presented by ***Victor Obeid*** *(RBTS, Inc. / USA)*

The first part of the course will focus on **FLUID-FILM BEARINGS**, the vital tribological element of rotating machinery, beginning with their fundamental principles of operation through computer-implemented evaluations of their operational performance characteristics and limitations. Design considerations and applications of fluid-film bearings will be discussed along with the presentation of numerous real-life case histories to illustrate the technology and its application to rotating machinery failure analysis and trouble-shooting of common, as well as, unique vibration problems. An **introduction to rolling element bearings** will be presented in **Seminar #2**.

Seminar #2 (Day 2+3) – presented by ***Victor Obeid*** *(RBTS, Inc. / USA)*

The second part of the course is divided into 2 subsequent days as many crucial topics are adressed. We start with an introduction in theory and practice of **ROTOR DYNAMICS**, i.e. **lateral vibration analysis** in rotating machinery from fundamental principles through present state-of-the-art analytical methodology to solve typical problems. The discussion of special and advanced topics is planned as well.



Furthermore, there will be an introduction to rolling element bearings illustrating their various applications and their effects on system rotor dynamics. The interacting influence of bearings on the dynamic behavior of machinery will be reviewed and illustrated by the construction of analytical models, and evaluated by computerized solutions.

Seminar #3 (Day 4) – presented by ***Dr. Andreas Laschet*** *(Laschet Consulting GmbH / Germany = channel partner)*

The third part of the course deals specifically with **TORSIONAL VIBRATIONS** as they occur in complete drivelines. Apart from model generation strategies, we present the basics of the analysis of excitability including the interpretation of vibration modes of the drive system. Examples show the steady-state or time-transient response signals generated by the calculations – also in comparison with measurement signals.

Seminar #4 (Day 4) – presented by ***Victor Obeid*** *(RBTS, Inc. / USA)*

The fourth part of the course will be a seminar with a workshop dedicated to all the subjects as presented in the days before. There will be LIVE software presentations showing **more specific details on special rotordynamic applications**, how to create computer models, how to run reasonable computations, and how to interpret and understand the computer results. This is a real technology transfer and training course covering real industrial case studies that could not be presented in Seminars #1 - #2.

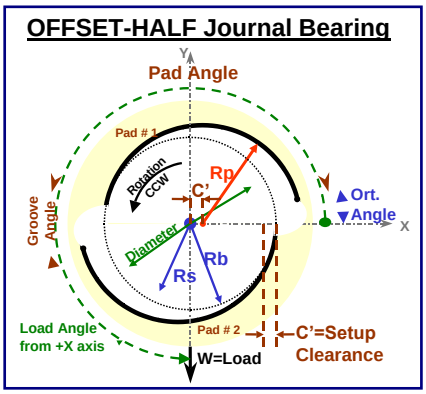
Seminar #1 (Day 1): FLUID-FILM BEARINGS

1st Day: November 11, 2024 **MONDAY** **09:00 – 17:00** UTC+1 (CET)

This seminar is presented in a simple way to understand the technology of **sliding surface bearings** so that participants with or without previous knowledge benefit from the presentation and can apply it immediately in their profession. The session is a full coverage of **FLUID-FILM BEARINGS** (the vital tribological elements of rotating machinery that support, guide, and locate the rotating assembly) beginning with their fundamental principles of operation through computer-implemented evaluations of their operational performance characteristics and limitations. Design considerations and applications of sliding surface bearings with emphasis on HYDRODYNAMICALLY lubricated fluid-film bearings will be discussed along with presentations of practical examples and case histories.

INTRODUCTION TO BEARINGS

- Functional Roll
- The Two Primary Classes
- Noteworthy Differences between the Two Classes of Bearings

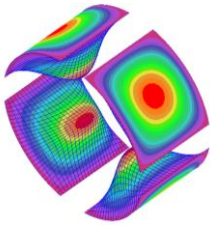


SLIDING SURFACE BEARINGS

- Fundamentals
- Types and Definitions
- Load Support Mechanisms
- Modes of Lubrication
- Frictional Response Characteristics
- Terms and Concepts of Hydrodynamic Lubrication and its Requirements
- Terms and Concepts of Hydrostatic-Hybrid Lubrication and its Requirements
- Lubricant Temperature / Viscosity Dependent Properties and Heat Balance Effects
- Turbomachinery Hydrodynamic Bearing Types, Performance, and Dynamic Characteristics
- Oil Whirl / Whip
- Advantages / Disadvantages
- Costs

FLUID-FILM BEARING TYPES AND APPLICATIONS

- Fixed & Tilting Pad Geometries
- Journal, Thrust & Conical



BEARINGS STATE-OF-THE-ART TECHNOLOGY

- Advanced Technology Presentation & Demonstration
- Summary of Course Content and Application of Bearings Technologies

Seminar #2 (Day 2 + 3): ROTOR DYNAMICS

2nd Day: November 12, 2024	TUESDAY	09:00 – 17:00 UTC+1 (CET)	Part 1: Basics
3rd Day: November 13, 2024	WEDNESDAY	09:00 – 17:00 UTC+1 (CET)	Part 2: Applications

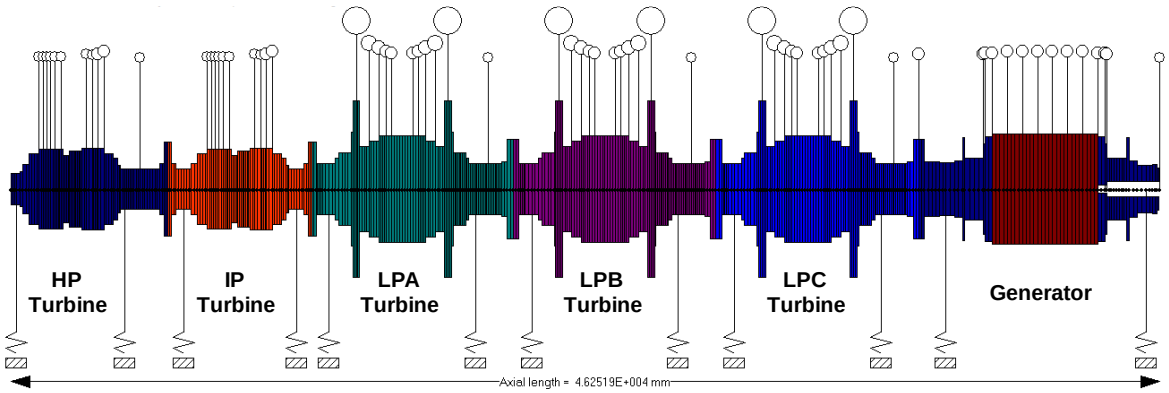
This 2-day seminar is presented in a simple way to understand the **ROTOR DYNAMICS** technology so that participants with or without previous knowledge benefit from the presentation and can apply it immediately in their profession. Commonly used terminology in the industry such as critical speed, mode shapes (rigid body and bending), stability, bearing whirl/whip, phase angle, critical damping, gyroscopic effects, unbalance, API amplification factors & required separation margins, etc. will be discussed and illustrated throughout the course by the presentation of practical examples and case histories. The course handout includes sufficient details to be used as a reference including a tutorial section on rotor dynamic fundamentals and terminology. The next day covers subjects on advanced applications in rotor dynamics and lateral vibrations.

INTRODUCTION & OVERVIEW

includes the presentation of real-life vibration problems and cost/time effective corrective actions taken as a solution

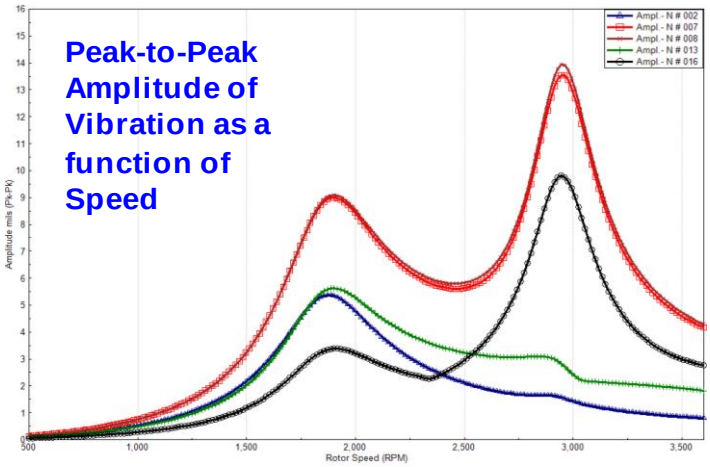
ROTOR DYNAMICS INTRODUCTION & APPLICATION

- **Basics** of Machinery Vibrations
- **Response & Shaft Dynamics**: Displacement, Velocity, Acceleration, Amplitude & Phase
- **Forces in Rotating Machinery**, Bearings, Cavitation, Imbalance, Hydraulic, Aerodynamic
- **Basics & Application** of Rotor Dynamics
- **Shaft Dynamics & Response** Controlling Mechanisms and Balancing
- **Modeling**: Shafting, Disks (Impellers, Couplings, Thrust Collars, Blades, Balanced Pistons, etc.), Bearings (Fluid-Film & Rolling Element), Seals (Wear-Rings, Labyrinth), Housing/Pedestal, Aerodynamic, Steam Whirl, Hydraulic Effects, External Excitations, Gyroscopic Effects
- **Analysis**: Damped & Undamped Rotor Stability, Natural Frequencies, Mode Shapes, Stability & Critical Speed Maps, and Responses



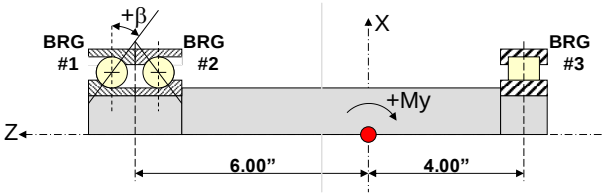
ROTOR DYNAMICS – ADVANCED

- **Synchronous** Steady-State Response
- **Non-Synchronous** Time-Transient Response
- **Balancing** – Grades & Guidelines
- **API Standards & Guidelines** – Amplification Factor, Critical Response Envelope. Required Separation Margins for Operation Below & Above Critical Speed, Shaft Vibration Orbit Properties

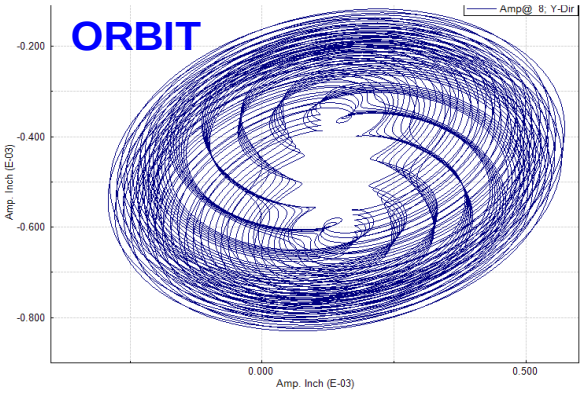


ROTOR DYNAMICS DETAILED CASE HISTORY

- **Step-by-Step Rotor-Bearing System Modeling**, Analysis, and Problem Solution by the Introduction of Rotor Dynamics Software and its Application to a Rotor-Bearing System
- **Bearing Interaction** with the Rotating Assembly, Oil-Whirl/Whip Phenomena, Rotor-Bearing Response, and Stability Illustrations

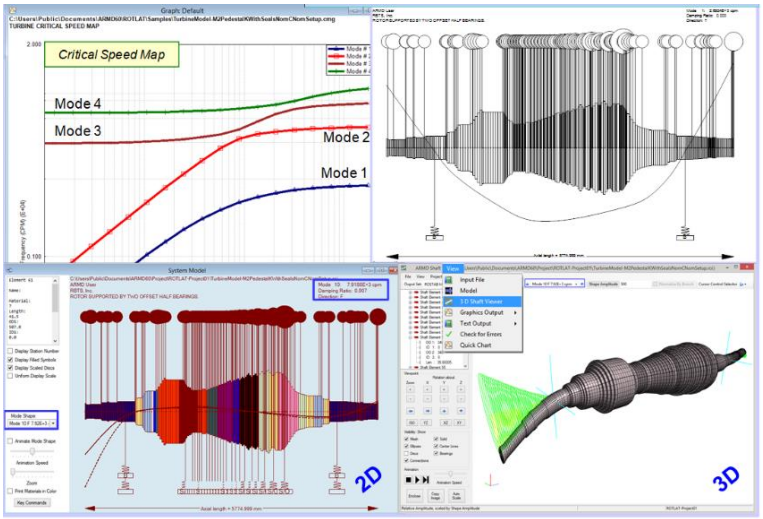


Coupling-End Bearing at Instability Threshold



STATE-OF-THE-ART TECHNOLOGY PRESENTATION & DEMONSTRATION

- Advanced Technology Presentation, Demonstration
- Summary of Course Content and Application of Rotating Machinery, Dynamics Technologies



During the session, numerous real-life case histories will be presented to illustrate the technology and its application to rotating machinery failure analysis and troubleshooting of common, as well as unique vibration problems.

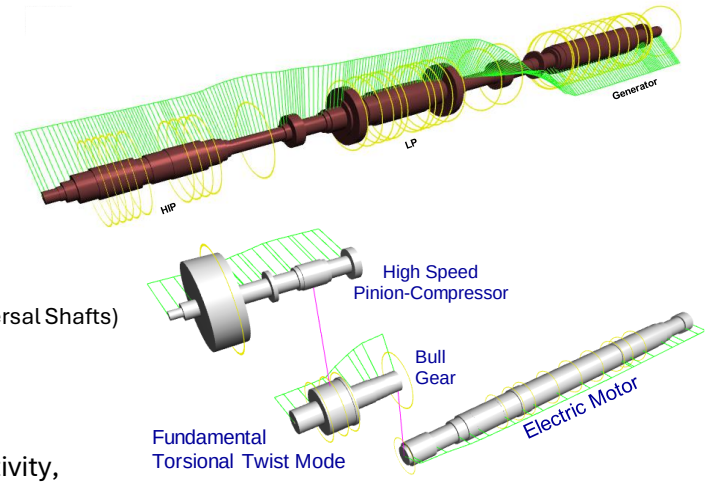
Please note: Attendees who are interested in details concerning the specific analysis of **TORSIONAL VIBRATIONS** in complete drivelines should also book the special seminar on the **4th day (Thursday)**.

Seminar #3 (Day 4): TORSIONAL VIBRATIONS

4th Day: November 14, 2024 **THURSDAY** **09:00 – 17:00** UTC+1 (CET)

This seminar will give interested participants more depth into the basics of **TORSIONAL VIBRATIONS** including case studies and applications in rotating machinery supported by computer simulation methods. This course is recommended as an additional session to the previous days. Complete drivelines are analyzed and evaluated concerning excitability and response capability at specific stations (inertias) and elements (stiffnesses).

The following subjects are covered:

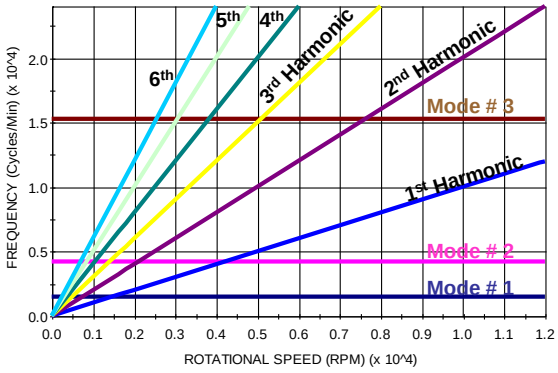


MODEL GENERATION

- Introduction & Problem Description
- Getting the "Right" Parameters
- Model Structures of Complete Drivelines
  (including Motors, Engines, Couplings, Gears, Universal Shafts)

ANALYSIS OF EXCITABILITY

- Natural Frequencies
- Modes and Interpretation of System Sensitivity, Model Refinement
- CAMPBELL Diagram & Discussing the Relevant Excitations

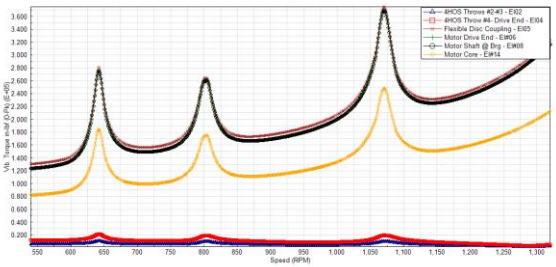


SIMULATION METHODS

- Simulation in the Time Domain (Time-Transient)
- Simulation in the Frequency Domain (Steady-State)
- Analysis of the System Response & Discussing Case Studies

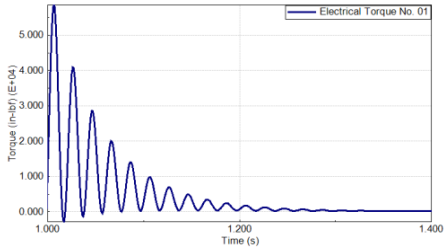
SYSTEM EVALUATION

- Evaluation Methods & Sensitivity Analysis Methods
- Correlation with Measurements
- Identification of Dynamic Effects & Machine Diagnosis
- Planning Further Steps towards System Optimization



APPLICATIONS

- TVA (Torsional Vibration Analysis) of a Total Drive System
- Drivelines with Motors, Engines & Reciprocating Compressors
- Electrical Effects (Start-Up, Short Circuits, Synchronous Motor Dynamics)
- Nonlinear System Behavior, Influence of Nonlinear Effects
  (like Gear Dynamics, Friction Hystereses, Rubber Influence in Flexible Couplings, Backlash & Impacts, etc.)
- Presentation of Computer Results, Demonstration of Case Studies
  (presented by ***Victor Obeid*** at the end of this seminar)



Seminar #4 (Day 4): SPECIAL SOFTWARE APPLICATIONS

4h Day: November 14, 2024 **THURSDAY** **09:00 – 17:00** UTC+1 (CET)

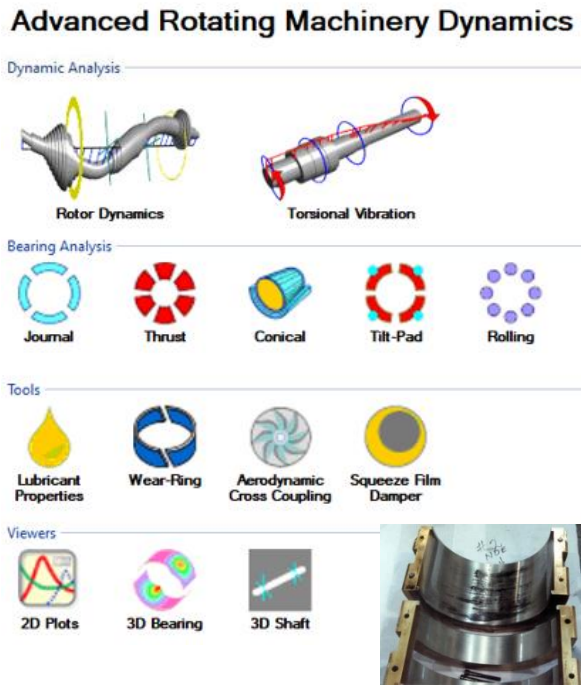
The last seminar day does include a **workshop** and is planned for participants who are interested in the **detailed modeling and analysis of rotor bearing systems and their interactions utilizing the ARMD Software**. Participants can bring their own rotating machinery problems to be presented and discussed in an open session, watch a problem developed and solved (as far as possible), or use the software and create their own models and perform the analysis of their interest. Time will be allocated to discuss FAQs and some details of the ARMD software, which has been used to solve the seminar sample problems. The **LIVE software presentations** show **more specific details on rotordynamic applications and case studies** which are not covered in the days before.

MODEL GENERATION

- Introduction & Problem Description
- Getting the "Right" Parameters
- Dividing the Rotating Machine into Components for Modeling and Integration
- Verification of Constructed Models

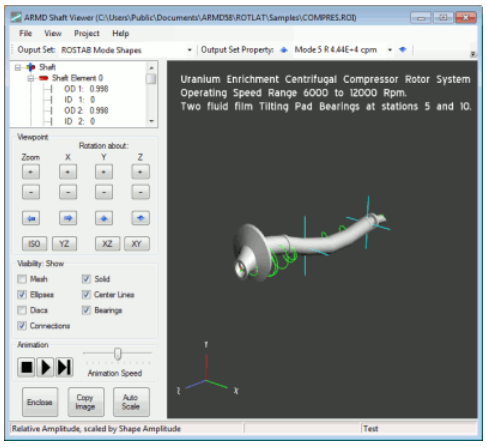
ROTOR/BEARING SIMULATION

- Deflection & Load Calculations
- Bearing Performance and the Generation of Dynamic Coefficients
- System Natural Frequency, Mode Shapes and Stability Calculations
- Critical Speed Map Generation
- Stability Map (CAMPBELL Diagram)
- Synchronous Unbalance Response
- Non-Synchronous Time Transient Response



INTERPRETATION OF RESULTS

- Acceptable Bearing Performance
- Rotating Machinery Dynamic Performance and Cost Effective Corrective Action
- Comparison / Correlation of Calculated and Measured Machinery Dynamic Performance



MORE DETAILED APPLICATIONS

- Participants' Problems
  (if available early before the seminar starts)
- Group / Instructor Sample Problem(s)
- Presenting Special TVA Applications
  (planned in the afternoon during the parallel TORSIONAL VIBRATION course, see Page 6)

If there is still time and interest from the participants, we are open for additional discussions.

About the Companies & Speakers

RBTS: A Tradition in Engineering Excellence

Established in 1986, *RBTS, Inc.* (USA) offers professional engineering services in rotating machinery dynamics, bearing systems, and structural engineering. *RBTS'* principals bring a versatile, yet highly specialized perspective to the solution of commonplace as well as unique engineering problems.

As an international leader in the design and development of software for rotating machinery dynamics, bearings, and seals, *RBTS* offers expertise in advanced rotor dynamic technologies. The engineering software, ***A**dvanced **R**otating **M**achinery **D**ynamics* (**ARMD**™) is currently in use by major corporations worldwide. Through its state-of-the-art software and service programs, *RBTS* provides computer-assisted technologies to companies to help them "test" the performance of rotating machinery during development and analyze machine failure in operation. Consulting services are available to supplement computer programs and for complex or unique machinery.

Through its principals, *RBTS* offers more than 60 years of combined experience. Senior consultants from these and other engineering fields also work with *RBTS*. Together, the *RBTS* network provides the most comprehensive engineering expertise available.

RBTS takes an integrated approach to problem-solving, analyzing the entire project to determine the impact of each component. Again, the collective expertise of *RBTS'* professionals means that the clients receive both generalized as well as specialized consultation.

From January 2024 *RBTS* is part of *Concepts NREC*®.

More information: www.rbts.com and www.conceptsnrec.com

About the Speaker:

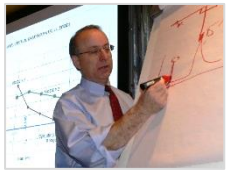
VICTOR K. OBEID has over 35 years of experience in the fields of rotor dynamics, fluid-film and rolling-element bearings, machinery vibration, failure analysis, and troubleshooting.

He is a pioneer in the development and application of PC-based state-of-the-art computer-aided design software for predicting the dynamics of complex rotor-bearing systems. A former Staff Engineer at the Franklin Institute Research Laboratories and a technical leader at *RBTS*, he directs government and industry-sponsored projects involving the design, analysis, and trouble-shooting of rotating machinery systems and their components.

He has been instrumental in teaching and training in the fields of bearings and rotor dynamics, and their application to common as well as unique equipment design, operation, and failure analysis. He taught seminars and training sessions worldwide at rotating equipment OEM, end users, packagers, government agencies, and open seminars to machinery engineers.

Mr. Obeid holds a Bachelor's degree from Drexel University and a Master of Science degree from Penn State University, both in Mechanical Engineering. He holds numerous US & Canadian patents on bearing designs & machinery elements.



LASCHET CONSULTING: From Tradition to Further Progress in Engineering Services

In 1918 *Arnold Laschet (senior)* set up a company in Essen (Germany), specialized in mechanical and electrical engineering, design of tools, fixtures, jigs, gears, devices, special machine tools, and made-to-order production. This is the start of the family-owned company. Since 1984 an independent company was established which covered – besides of modular machine tool machines – also powerful engineering services, and the development and sale of technical software products.

This tradition was continued with the company *Laschet Consulting GmbH*, officially started in 2016 as a consulting and engineering service ... with decades of experience.

To be able to meet the increasing demands made on the simulation of vibrations, *LASCHET* started a close cooperation with *RBTS, Inc.* (USA) for more than 20 years to offer the rotor dynamics software **ARMD™** and the accompanying engineering services in Europe, in the Middle East, and also worldwide. **ARMD™** is used to calculate the dynamic behavior (torsional & lateral vibrations including the bearing behavior) in drive systems. Typical applications are found in all rotating machinery, and many other applications related to power transmission engineering.

Since *LASCHET* offers both software support and engineering services, there is always a reference to practical use and customer-oriented verification of this kind of computer simulation. Worldwide, a lot of customers in R&D and testing departments use the software with great success. Customer training courses and consultancies (mostly supported as online service) complete the range of services.

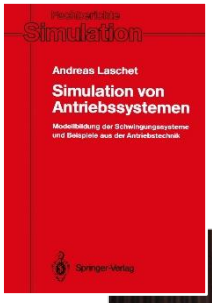
The cooperation between *LASCHET* and *RBTS* started already 25 years ago. Therefore both partners provide an international professional engineering and software service as part of an acknowledged expert team with many years of experience ... with excellent references and feedback from customers around the world. From 2024 *LASCHET* is also a rotor dynamics channel partner of *Concepts NREC*.

More information: **www.laschet.com**

About the Speaker:

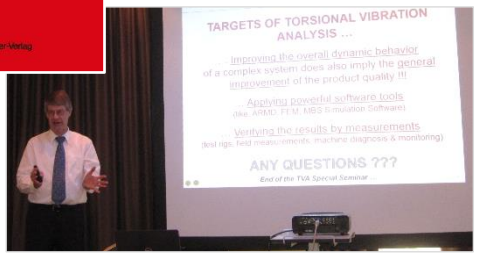
The head of the company, **Dr. ANDREAS LASCHET**, studied „Mechanical Engineering“ at the University of Technology in Aachen (Germany) and carried out research work in the field of machine dynamics as a scientific assistant at the Institute of Machine Elements. His thesis "*Development of a method for the computer supported simulation of torsional vibrations in drive systems*" was published in 1988 as a Springer book “*Simulation of the Dynamic Behaviour of Drive Systems*” (in German language).

He was one of the pioneers who carefully investigated CAE methods and simulation algorithms for creating torsional vibration models of complete drivelines (not only single drive elements) and performed detailed studies to verify computer results with measurements. This was usually done as part of his engineering services.



Furthermore, he published more than 60 technical papers and gave numerous lectures at international conferences (like VDI, HDT, EFRC, ASME, SAE).
He conducted many custom workshops and – as part of the collaboration with *RBTS* – since 2004 an extended seminar on torsional vibrations during the annual rotor dynamic lectures.

His expertise is based on more than 40 years of professional experience.



Seminar Organization & Registration & Costs

All courses are **HYBRID SEMINARS**, realized as **in-person seminars** at the *Maritim Hotel in Frankfurt (Germany)* and – alternatively – also as **online seminars** in a digital classroom (except for AP1). The in-person and online seminars take place simultaneously. The language is **ENGLISH** only. The **seminar documents** matching the booked seminars are supplied **as PDF files**; we will not provide printed manuals).

The **seminars** will be on **4 subsequent days** according to the **following schedule** with the time specifications **"CET = Central European Time"** (= **UTC+1**). The seminars #3 + #4 will take place in parallel.

Seminar #1 → **FLUID-FILM BEARINGS** → Booking Code: **FB1**
Nov 11, 2024 **09:00 – 17:00 = 9:00 a.m. – 5:00 p.m.** UTC+1 (CET)

Seminar #2 → **ROTOR DYNAMICS – Part 1**
Nov 12, 2024 **09:00 – 17:00 = 9:00 a.m. – 5:00 p.m.** UTC+1 (CET)

→ **ROTOR DYNAMICS – Part 2**
Nov 13, 2024 **09:00 – 17:00 = 9:00 a.m. – 5:00 p.m.** UTC+1 (CET)

Seminar #2 can only be booked as a package for the mentioned 2 days. → Booking Code: **RD12**

The seminars #3 + #4 take place on the same day at the same time.
*You can only register for **one** of the two seminars.*

Seminar #3 → **TORSIONAL VIBRATIONS** → Booking Code: **TV1**
Nov 14, 2024 **09:00 – 17:00 = 9:00 a.m. – 5:00 p.m.** UTC+1 (CET)

Seminar #4 → **SPECIAL SOFTWARE APPLICATIONS** → Booking Code: **AP1**
Nov 14, 2024 **09:00 – 17:00 = 9:00 a.m. – 5:00 p.m.** UTC+1 (CET)

To **REGISTER**, please go to the website event page, and choose between "In-Person Student" and "Online Student". The system will prompt you to purchase the seminars by booking code.

If you have any further questions about this or have problems with the online booking, please contact directly the organizing office info@conceptsnrec.com.

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Claudio Lorenzo Raia
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SEMINAR PRICES and BOOKING DETAILS

See the following table with the **allowed booking combinations** including the corresponding **seminar fees (in USD currency)**.

PRICE LIST & BOOKING MATRIX *(bookable combinations)*

Seminar Day	1	2	3	4		Booking Code	Price [$] - net -
Seminar Date	11 Nov 2024	12 Nov 2024	13 Nov 2024	14 Nov 2024			
Time per Day	09:00 - 17:00 (UTC+1 = CET) (9:00 a.m. - 5:00 p.m.)						
Content / Code	FB1	RD12		TV1*	AP1*		
Booking of 1 Day	X					FB1	790.00
				X		TV1 or AP1	
Booking of 2 Days		X	X			RD12	1,490.00
	X			X		FB1-TV1 or FB1-AP1	
Booking of 3 Days	X	X	X			FB1-RD12	1,990.00
		X	X	X		RD12-TV1 or RD12-AP1	
Booking of 4 Days	X	X	X	X		FB1-RD12-TV1 or FB1-RD12-AP1	2,390.00

FB1 = Fluid-Film Bearings; RD12 = Rotor Dynamics; TV1 = Torsional Vibrations; AP1 = Software Applications
**) Only one seminar can be booked at the 4th day: either TV1 or AP1. The seminar AP1 is not available as online seminar.*

Although you can also book the seminar days individually (see table above), we recommend booking the **COMPLETE seminar package (4 days)**, as all the seminar topics are perfectly coordinated.

If you book the seminar as an **ONLINE seminar** we grant a **discount of 10%**. Please use RBTSONLINE10 Please note that the seminar AP1 cannot be booked as an online seminar; this seminar is exclusively for on-site participants.

If you book the seminar as an **IN-PERSON (ON-SITE) seminar** we grant an **early-bird discount of 15%** if you book by September 1, 2024 (please use RBTSEARLY15) and **10%** if you book by October 11, 2024 (please use RBTSEARLY10).

Note: discounts cannot be combined

The seminar fee contains the **attendance of the seminar**, the **seminar documents**, and only in case of in-person seminars: **lunch, refreshments during the breaks, getting together in the evening with drinks & snacks** (Nov 11, 2024), **evening event at a typical German restaurant** (Nov 12, 2024).

CERTIFICATES OF ATTENDANCE will also be issued, which will be emailed individually after the event.

Important for the IN-PERSON SEMINAR: Location & Accomodation & Travel Details

The seminar will take place at the following hotel:

Maritim Hotel Frankfurt
Theodor-Heuss-Allee 3
60486 Frankfurt/Main
Germany

Phone: +49 69 7578-0
Fax: +49 69 7578-1000
Reservation phone: +49 69 7578-1130
info.fra@maritim.de

Book Accommodations Now

HOTEL BOOKING LINK DE

HOTEL BOOKING LINK EN

Maps & Transportation

The Maritim Hotel Frankfurt is linked directly with the trade fair and the Congress Centre. Its central location is ideally located with the motorways A5 and A3 just a few minutes away. The main railway station is just one U-Bahn station away and the airport is just 15 minutes away by road.

Due to other conventions and trade fairs which take place during the same period, we recommend booking your hotel room **as soon as possible**.

Frankfurt has an excellent central location in Europe and offers the best international flight connections from Germany as well as a very good rail connection (IC, ICE); several highways are in the immediate vicinity.