

# ***GEAR DYNAMICS AND GEAR NOISE SHORT COURSE***

to be held at  
Fawcett Center  
The Ohio State University Campus  
Columbus, Ohio 43210, USA

Taught by  
Dr. Donald R. Houser, Dr. Rajendra Singh,  
Dr. Ahmet Kahraman, and Dr. David Talbot  
NVH & Gear Education  
<http://www.nvhgear.org/>

September 17-20, 2018  
(Monday - Thursday)

## **GEAR DYNAMICS AND GEAR NOISE COURSE**

- *Gear Whine and Rattle*
- *Transmission Error - The Main Source*
- *Measurements for Gear Noise Diagnosis*
- *Noise, Vibration and Harshness Issues*
- *Gear Tooth, Shaft & Bearing Dynamics*
- *Profile Design, and Manufacturing Issues*
- *Transmission Paths and Housing Acoustics*
- *All Types of Gears including Hypoids*
- *Noise and Vibration Reduction Techniques*
- *Laboratory Demonstrations*
- *Demo of GearLab Computer Software*
- *Design Guidelines & Optimization*

## **PURPOSE**

The purpose of this unique short course is to provide a better understanding of the mechanisms of gear noise generation, methods by which gear noise is measured and predicted, and techniques employed in gear noise and vibration reduction. Over the past 39 years more than 2050 engineers and technicians from over 375 companies have attended the Gear Noise Short Course.

## **WHO SHOULD ATTEND**

The course is of particular interest to engineers and technicians involved in the analysis, manufacture, design specification, or utilization of simple and complex gear systems. Industries that find this course helpful include the automotive, transportation, wind-energy, process machinery, aircraft, appliance, general manufacturing, and all gear manufacturers.

The course material is covered in such a way that the fundamentals of gearing, gear dynamics, noise analysis and measurements are covered first. This makes the course appropriate to the gear designer with minimal knowledge of noise and vibration analysis as well as to the noise specialist with little knowledge of gears.

## **COURSE LECTURES (FIRST 3 DAYS)**

A popular feature of this course is the interspersing of demonstrations with lectures. The extensive measurement and computer software capabilities of the Gear and Power Transmission Research Laboratory allow us to do this in a simple and non-commercial manner.

On the first day, the lecturers discuss why even perfect gears make noise. They present in both qualitative and quantitative terms how gear design parameters and

manufacturing errors affect noise. The concept of gear transmission error, one of the major contributors to gear noise, is developed, and methods of predicting transmission errors from design and manufacturing data are presented. Participants get a clear physical insight into the problems they face and how they may apply course knowledge to help solve their gear noise problems.

On the second day, lecturers concentrate on gear system dynamics and acoustics, dynamics of parallel axis and planetary gears, transmission error calculations and measurements. The role of spacing error will be discussed as well.

The third day's lectures briefly discuss the sources and simulation models of gear rattle as well as spending several hours in the case history workshop.

### CASE HISTORY WORKSHOP ON DAY 3

This novel approach to discussing "real life" gear noise and dynamics problems has been used in this course since its inception. The workshop, which has been lauded by past attendees for its practical flavor, takes place on the third day of the course. The purpose of this workshop is to allow the course instructors and participants to interact and to discuss gear noise and dynamics case histories presented by course attendees. They are asked to present a brief synopsis of problems they have encountered or of a procedure they have used for gear noise analysis and reduction. Possible approaches to solve each problem will be discussed.

### LABORATORY DEMONSTRATIONS ON DAY 2

Throughout the course, laboratory and computer software demonstrations are used to illustrate gear noise measurement and analysis techniques. The facilities of the Gear and Power Transmission Research Laboratory ([gearlab.org](http://gearlab.org)) and the Acoustics and Dynamics Laboratory ([autonvh.org](http://autonvh.org)) are used for these demonstrations.

### SIMULATION AND EXPERIMENTAL METHODS SESSIONS ON DAY 4

The sessions on Day 4 will address the following topics and related simulation or experimental methods:

- a. Planetary gear dynamics and modulations
- b. Casing vibration, acoustics and system models
- c. Advanced gear excitation measurement
- d. Gear rattle and vehicle clunk case studies
- e. Verification and experimental validation issues

See web page ([www.nvhgear.org](http://www.nvhgear.org)) for more details.

## COURSE INSTRUCTORS

- **Dr. Donald R. Houser**  
(Emeritus Professor and Founder of OSU GearLab)
- **Dr. Rajendra Singh**  
(Emeritus Professor and Director of OSU Acoustics & Dynamics Laboratory)
- **Dr. Ahmet Kahraman**  
(Professor and Director of OSU Gear and Power Transmission Research Laboratory)
- **Dr. David Talbot**  
(Research Assistant Professor)

Please go to [nvhgear.org](http://nvhgear.org) for bios.

## GENERAL INFORMATION

### Registration:

1. Advance registration is required and should be completed as soon as possible. Payment details (via major credit card) are posted on the web site. Applicants are usually accepted on a first come, first served basis to the limit of the course. However, the organizers reserve the right to limit admission to the best qualified.
2. Course payment must be completed along with or immediately after the registration to confirm the attendance.
3. The latest agenda, nearby hotels, parking, airport transportation, and other relevant information are posted on the web page ([nvhgear.org](http://nvhgear.org)).

### Contact:

- Dr. Rajendra Singh (614-292-9044, [singh.3@osu.edu](mailto:singh.3@osu.edu) or [singh@nvhgear.org](mailto:singh@nvhgear.org)) for registration information.
- Dr. Donald R. Houser (614-292-5860, [houser.4@osu.edu](mailto:houser.4@osu.edu) or [houser@nvhgear.org](mailto:houser@nvhgear.org)) should be contacted for technical information and workshop topics.

# Agenda for Gear Dynamics & Gear Noise Short Course – 2018 (subject to change)

## MONDAY: SEPT. 17 (DAY 1)

8:00 AM	Registration	
8:15 AM	Introduction and overview	Dr. Don Houser
8:30 AM	Gearing fundamentals	Dr. Don Houser
9:15 AM	Simplified gear noise sources and frequency analysis	Dr. Don Houser
10:00 AM	Break	
10:15 AM	Sound measurement	Dr. Raj Singh
12:00 PM	Lunch	
1:00 PM	Sound perception issues and spectrum analysis demo	Singh / Houser
1:30 PM	Transmission error concepts	Dr. Don Houser
2:05 PM	Basic gear dynamics – I	Dr. Raj Singh
3:00 PM	Break	
3:15 PM	Basic gear dynamics - I (concluded)	Dr. Raj Singh
3:30 PM	Transmission error modeling and measurement	Dr. Don Houser
5:00 - 6:30PM	Networking Reception	

## TUESDAY: SEPT. 18 (DAY 2)

8:15 AM	Gear noise guidelines (and how results are displayed in literature)	Houser / Singh
9:00 AM	Basic gear dynamics - II (concepts and simulation)	Dr. Raj Singh
10:00 AM	Break	
10:15 AM	Effects of spacing errors on gear design and gear dynamics	Talbot/Houser
12:00 PM	Lunch	
1:00 PM	Planetary gears: Kinematics, load sharing and modeling	Dr. Ahmet Kahraman
2:30 PM	Casing dynamics & acoustics - I	Dr. Raj Singh
3:00 PM	Break	
3:15 PM	Casing dynamics and acoustics - I (contd.)	Dr. Raj Singh
3:40 PM	Transport to OSU Campus (Scott Lab) by Bus	
4:00 PM	Transmission error measurement (demo)	Dr. Houser et al.
4:30 – 6:15 PM	Tours and demos: OSU GearLab and Acoustics & Dynamics Laboratories	
6.30 – 6.45 PM	Bus brings attendees back to Fawcett Center	

## WEDNESDAY: SEPT. 19 (DAY 3)

8:15 AM	Summary and discussion	Houser / Singh
8:30 AM	Casing dynamics and acoustics – II	Dr. Raj Singh
9:00 AM	Gear rattle (physics, modeling and simulation demo)	Dr. Raj Singh
10:00 AM	Break	
10:15 AM	Gear rattle (concluded)	Dr. Raj Singh
10:45 AM	Advanced transmission error topics	Dr. Don Houser
12:00 PM	Lunch	
1:00 PM	Case history workshop (10-minute presentations by attendees)	
3:00 PM	Break	
3:15 PM	Workshop (concluded) and Design optimization and robustness	Dr. Don Houser
5:00 PM	Adjourn	

## THURSDAY: SEPT. 20 (DAY 4)

8:00 AM	Overview of Day 4 topics, summary and validation studies	Dr. Raj Singh
8:30 AM	Planetary gears: dynamics and modulation	Dr. Ahmet Kahraman
10:00 AM	Break	
10:15 AM	Geared system dynamics and acoustics	Dr. Raj Singh
11:45 PM	Boxed Lunches (and LDP Demo - optional)	
12:45 PM	Advanced gear excitation measurement	Dr. Don Houser
2:15 PM	Break	
2:30 PM	Gear rattle and vehicle clunk (case studies)	Dr. Raj Singh
4:00 PM	Adjourn	

# REGISTRATION

Please register me in the **GEAR DYNAMICS AND GEAR NOISE SHORT COURSE**  
September 17 – 20, 2018 (Monday – Thursday)

*(please type or print)*

**Name:**

First

(Middle)

Last

**Name for badge:**

**Company:**

**Position:**

**Address:**

City

State

Zip Code

Country

**Phone number:**

**Fax number:**

**E-mail:**

**How did you  
hear about us?**

**Please register me for:**

- \$2,200 per person – early bird rate (valid until July 31, 2018)
- \$2,400 per person – regular rate
- Vegetarian meals requested

**Payment of \$ \_\_\_\_\_ will be paid by:**

- Check (payable to NVH & Gear Education)
- Major Credit Card (Information needed is posted on the web site)

***Note that we can NOT accept a purchase order.  
Additional charges may apply for invoicing, wire transfer, etc.***

- Case History Workshop:** I would be interested in speaking briefly on the following problem or topic in the workshop on Day 3.

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Please send this form (and credit card information) to:

Prof. Raj Singh via email at ([singh.3@osu.edu](mailto:singh.3@osu.edu) or [singh@nvhgear.org](mailto:singh@nvhgear.org))

Mail the check to: NVH & Gear Education, PO Box 3201, Dublin, OH 43016, USA