GIAN Course on

Shockwave Reflection Phenomena

Overview

Shock waves in supersonic fluid flows are discontinuities that change the entire flow characteristics owing to their own existence and their interaction with other fluid dynamic phenomena. These interactions will induce unwanted aerodynamic forces on bodies moving with supersonic and hypersonic speeds and unpredictable fluid dynamic phenomena in supersonic internal flows (nozzles, combustions chambers, etc.). Much has been learnt about the existence of shock waves over the years, but little is known about its interactions with other fluid dynamic processes. Shock wave reflection is one of the most important fluid dynamic processes, which has been investigated rigorously over the past 80 years owing to its profound impact on fluid dynamic behaviour of supersonic and hypersonic flows. Hysteresis is the major fluid dynamic phenomenon which is associated with the shock wave reflection which makes the prediction of aerodynamic forces on supersonic and hypersonic bodies extremely difficult. The findings regarding the existence of hysteresis loop could be of utmost importance in designing the intakes of supersonic and hypersonic vehicles. Research works in this field were collected and compiled nicely in the famous book "Shock Wave Reflection Phenomena" by Prof. G. Ben-Dor in Ben-Gurion University of Negev, Israel. The course is planned based mainly on this book and other recent works being pursued in this area. The recent efforts in India to indigenously develop supersonic and hypersonic vehicles are expected to be enhanced by the introduction of such specialized topics when the experienced researchers across the world share their knowledge to the Indian scientific community. The course is expected to give the participants a fundamental understanding of the shockwaves in supersonic flows and its impact on the aerodynamic characteristics of high-speed systems.

Dates for the Course	**1st of January 2018 to 12th of January 2018**
Host Institute	**IIT Madras**
No. of credits	**2**
Max. no. of Participants	**40**
You Should Attend If you are	▪ an Aerospace Engineer interested in the aerodynamic design of various internal and external systems of high-speed flying objects such as rockets, jet air crafts, missiles, artilleries and bullets. ▪ a faculty or a research student interested in learning the fundamental phenomenon of shock waves and its behaviour. ▪ a 3rd/4th year under graduate student or a graduate student interested to know the fundamental problems in high-speed flows involving shockwaves.
Fees	The participation fees for crediting the course is as follows: **Participants from abroad : US $400, Student Participants : Rs.2000/-, Faculty Participants: Rs. 4000/-** **Research organisations: Rs. 7000/-, Industry: Rs. 12000/-** The above fee include all instructional materials, computer use for tutorials and assignments, laboratory equipment usage charges, 24 hr free internet facility. **Modes of payment:** Online transfer: Account Name: CCE IIT Madras Acc. No.: **36401111110** Branch: SBI, IIT Madras Branch, Chennai IFSC Code: SBIN0001055 SWIFT Code: SBININBB453 **OR** Demand draft in favour of **"Registrar, IIT Madras"** payable at **Chennai**. The demand draft is to be sent to the Course Coordinator at the address given below.
Accommodation	The participants may be provided with hostel accommodation, depending on availability, on payment basis. Request for hostel accommodation may be submitted through the link: http://hosteldine.iitm.ac.in/iitmhostel/

The Faculty

Prof. Gabi Ben-Dor is Professor and Head of Protective Technologies Research & Development Center in Ben-Gurion University of the Negev, Beer Sheva, Israel. His research interests include shock wave reflection in steady, pseudo-steady and unsteady flows, shock wave propagation in dust-gas suspensions, shock wave interaction with porous and cellular materials, transport phenomena in porous media, turbulent mixing (Kelvin-Helmholtz, Rayleigh-Taylor and Richtmeyer-Meskov instabilities) Penetration and Protective structures.

Dr. G Rajesh is Associate Professor in the Dept. of Aerospace Engineering, Indian Institute of Technology Madras. His research interests are transient high–speed flows in ducts, high-speed open and confined jets, steady and pseudo-steady shockwave reflections, shock and expansion wave diffractions, transitional ballistics, and blast wave phenomena.

Course Co-ordinator

Dr. G. Rajesh

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Register for the course @
http://www.gian.iitkgp.ac.in/GREGN/index

Address:

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Associate Professor
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IIT Madras, Chennai
Tamil Nadu - 600 036

Detailed schedule

Date	Topics	Faculty
01-01-2018	Supersonic flow and normal shocks	Prof. Ben-Dor
	Review problems	Dr. Rajesh
02-01-2018	Oblique shocks	Prof. Ben-Dor
	Review problems	Dr. Rajesh
03-01-2018	Flow through multiple shock systems	Prof. Ben-Dor
	Review problems	Dr. Rajesh
04-01-2018	Shock polar presentation, two and three-shock theories of *von*-Nuemann	Prof. Ben-Dor
	Steady reflections in weak and strong shock domains using shock polar, review problems	Dr. Rajesh
05-01-2018	Various transition criteria for regular to irregular reflections (RR to IR)	Prof. Ben-Dor
	Typical cases of steady reflections – review problems	Dr. Rajesh
08-01-2018	Prediction of Mach stem size – Azevedo's method and Li and Ben-Dor's method	Prof. Ben-Dor
	Prediction of Mach stem size – Motoun's method and Gao's method	Dr. Rajesh
09-01-2018	Hysteresis phenomenon- wedge angle induced-Symmetric reflection	Prof. Ben-Dor
	Mach reflection in open jets – Background	Dr. Rajesh
10-01-2018	Hysteresis phenomenon- Mach no. & perturbation induced, Asymmetric reflection	Prof. Ben-Dor
	Review problems	Dr. Rajesh
11-01-2018	Mach stem height prediction in over expanded and under expanded open jets	Dr. Rajesh
	Experiments on open jet shock reflections	Dr. Rajesh
12-01-2018	Shock reflections in pseudo-steady flows	Prof. Ben-Dor
	Final Examination and conclusion	Dr. Rajesh

(Morning Sessions: 10 am -12 noon, Afternoon sessions: 2 pm - 4 pm)