SEMINAR - סמינר

הנך מוזמן/ת להרצאה סמינריונית של הפקולטה להנדסת מכונות, שתתקיים ביום ב' 17.01.22
(ט"ו בשבט תשפ"ב), בשעה 14:30, הסמינר יתקיים באמצעות הזום:
https://technion.zoom.us/j/95005024947

מרצה:

Dr. Igal Gluzman
Department of Aerospace and Mechanical Engineering, University of Notre Dame, Indiana, USA.

על הנושא:

Cavitation and bubble dynamics in aviation fuels

The seminar will be given in English

להלן תקציר ההרצאה:

Cavitation in the aircraft fuel systems can lead to unexpected material degradation and damage to fuel-system components. Thus, it is important to be able to accurately model fuel cavitation inception, bubble growth, and collapse. This is challenging due, in part, to the fact that fuels are a complex mixture of hundreds of hydrocarbons and additives. Furthermore, the dissolved gas content in fuels is affected by their storage history, and gaseous cavitation often occurs. This study is focused on the fundamental understanding of cavitation inception, shock wave generation mechanisms, and nonspherical bubble dynamics interactions in aviation fuels via rigorous experimental studies and modeling efforts.

First, the shock wave generation and propagation mechanisms in aviation fuel cavitation are characterized in a generic converging-diverging nozzle geometry. We provide unprecedented quantitative data on shock wave emission and propagation characteristics via a novel high-speed image processing technique we term "enhanced gradient shadowgraphy." It is shown that two sustained independent mechanisms are responsible for shock wave generation in the choked flow regime. We obtain nonlinear solutions of the governing equations for nonbarotropic homogeneous flow to predict shock speeds. Good agreement is obtained with the newly acquired experimental data.

Second, a novel approach is presented for extracting quantitative data via computer vision algorithms from non-intrusive high-speed imaging techniques applied to the quantification of the bubble spatial-temporal evolution, breakup kinematics, and cavitation inception mechanisms in aviation fuels. It is shown that the initial bubble size plays an essential role in the resulting void fraction variation after the breakup, but not in the breakup kinematics. We also define a unique dimensionless parameter that allows the prediction of the bubble breakup event for different fuels and flow regimes.

Lastly, we present a new model to predict cavitation collapse in radial flow between two parallel disks with a thin gap which represents a geometry highly relevant to aviation fuel pumps and their operating conditions. A spatial Rayleigh-Plesset equation was derived and adapted to model the bubble collapse in the disk geometry. Our model prediction shows remarkable agreement with our experimental data. Results from our study shed light on the complex physics of fuel cavitation and the dynamics of a group of nonspherical cavities.

Bio: Dr. Igal Gluzman is a Postdoctoral Research Associate in the Department of Aerospace and Mechanical Engineering at the University of Notre Dame (2020-present). Prior to that, he was a Postdoctoral Fellow in the Department of Mechanical Engineering at Johns Hopkins University (2018–2020). He received his Ph.D. (2017) from the Faculty of Aerospace Engineering at the Technion and both M.Sc. (2013) and B.Sc. (2011) from the Department of Mechanical Engineering at Ben-Gurion University. His research interests include cavitation and bubble dynamics, transitional and turbulent boundary layers, and smooth body flow separation. In his research, he employs interdisciplinary approaches from dynamical systems, signal processing, estimation, computer vision, and photogrammetry.

מארח: פרופ' אולג גנדלמן

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