uniform free stream Mach number of 1.63. The Reynolds number of the boundary layer at the leading edge of the cavity is found out to be 1.47548e+07. For constant length to depth ratio (L/D=3) trailing wall angle of cavity was varied. Experiments were performed on six different trailing wall angle cavities to understand its effect on the unsteadiness of cavity flows. A measurement of unsteady surface pressure at various locations inside the cavity was carried out. Standard statistical analysis methods have been used to obtain various quantities of interest including the spectral distributions. On the analysis of pressure signals, reduction in amplitudes of the modes was observed as the angle decreases to lower value. High magnitude oscillations were observed for 90 and 75 degrees cavities. Steep fall in amplitudes of oscillations was noticed as the angle is reduced below 75 degrees. Virtually no oscillation was observed for cavities with 30 and 15 cavities. Temporal mode switching was observed dependent on trailing wall angle of the cavity. Multiple modes exist as the trailing wall angle is reduced to a lower value. Existence of strong acoustic wave inside the cavity responsible for high amplitude oscillations in 90 and 75 degrees trailing wall angle cavities was detected. It is noticed that as the trailing wall angle was reduced below 75 degrees the feed back mechanism has weakened considerably. It is found that overall cavity behavior changes significantly as the trailing wall angle is reduced below 75 degrees.

T-2E-2. COMPUTATIONAL STUDY ON THE OPERATING PROCESSES OF A TWO-STAGE LIGHT-GAS GUN

G. RAJESH, *Department of Mechanical Engineering, College of Engineering, Trivandrum, Kerala, India*, H. D. KIM, *Andong National University, Korea*, Y. K. LEE, *Poongsan Company, Chungnam, Korea,* Two-stage light gas guns are commonly used to simulate projectile velocities in the ballistic regimes, and have been extensively been used in hyper-velocity impact engineering, supersonic and hypersonic projectile aerodynamics and aeroballistics. In general, the conventional two-stage light-gas gun consists of three tubes, two diaphragms, a piston and a projectile. The high-pressure tube serves as the reservoir of high-pressure gas. The pump tube, which contains a light-gas, to increase the speed of sound, is connected to the high-pressure tube through a diaphragm separating both at the junction. A massive, freely movable piston is placed near the diaphragm in the pump tube. Projectile is kept in the launch tube which is connected to the pump tube through another diaphragm. Rupture of the diaphragm between the high-pressure tube and pump tube causes the piston to move at a high-speed and isentropically compress the light-gas to a much higher pressure than that in the high-pressure tube. With this rapid rise of the pressure inside the pump tube, a state is reached at which the second diaphragm ruptures and shock tube flow is initiated with the production of a strong unsteady shock wave in the launch tube. Resulting high-pressure state just behind the projectile produced by the reflection of the shock wave from the projectile base, drives the projectile with a very high-velocity. The performance of such a two-stage light-gas gun can be determined by the projectile speed at a given pressure in the high-pressure tube and a given mass of the piston. In this case, the projectile speed is dependent on many other parameters such as, the kind of light-gas (driver gas), the length and diameter of each tube, the isentropic compression process due to the piston motion and the shock compression on the base of the projectile. A large number of the works have been carried out analyze the processes inside the two-stage light-gas gun. However, none of the works has focused on the complete simulation of the device, which is very much important in terms of the fluid dynamic and structural aspects of the device. In the present study, a CFD method has been applied to predict the compressible flow field inside the two-stage light-gas gun, and to find out the dependence of several operating parameters on the projectile velocity and the peak pressures in the device, aiming at the performance enhancement of the two-stage light-gas gun. The unsteady, compressible Euler equations were numerically solved using a fully implicit finite volume method. The chimera scheme was employed to simulate the moving piston in the pump tube and the motion of the projectile in the launch tube. The computational results are compared with experimental data and found to be in very good agreement. Based on the computational results, it is seen that the complete interior ballistics of such guns can be simulated using CFD method with reasonable accuracy.

T-2E-3. EXPERIMENTAL STUDY OF ACTIVE CONTROL IN TRANSONIC DIFFUSER

M. YAGA, *University of the Ryukyus*, *Japan*, Y. UECHI, *University of the Ryukyus*, *Japan*, S. MATSUDA, *Okinawa National College of Technology*, *Japan*, I. SENAHA , *University of the Ryukyus*, *Japan,* Preliminary experiments of an active control of shock waves and the pressure fluctuations in a transonic diffuser were carried out using a piezo actuator attached at a throat of the diffuser. The experiments were performed with a 0.7MPa blow down wind tunnel. The test section consists of a 500mm circular arc half nozzle and the piezo actuator set at the throat. The flow was measured with the high response semiconductor pressure sensors and observed with the high speed camera by mean of schlieren technique. As the input signals to the piezo actuator, the sinusoidal voltage of 100Hz and 200Hz were adopted. As expected, the shock wave in the diffuser has clear correlation with the piezo actuator, where the dominant frequency of the unsteady positions of the shock wave is exactly the same as the input frequency. It is also confirmed that the flow pattern and the shape of the shock wave remain unchanged under the different input frequencies. The time averaged shock positions increases with the wind tunnel pressure ratio, which means that the oscillating shock wave moves downstream monotonically with the increase in the wind tunnel pressure ratio. The rms (root mean square) of the wall static pressure ratio also provide us with the information on where and how the shock wave approaches to the five monitoring positions. It illustrated the clear peaks at different pressure ratios at each monitored position. These clear peaks are caused by the large pressure difference between downstream and upstream of the approaching shock wave. However, the results of detailed FFT analyses of the wall static pressure fluctuations under various pressure ratio show that for the input frequency of 100Hz the dominant frequency is the same as the input frequency until the shock wave is located downstream of the monitored position. It also must be noticed that when the shock wave approached from upstream of the monitoring position, the spectrum of the relatively low frequencies than the input frequency becomes large. On the other hand, in case of f=200Hz, although the dominant frequency is still the same as the input frequency, the low frequencies have much less spectrum power than that for f=100Hz. However, when the state of the flow at the monitoring position becomes supersonic due to the increase in the pressure ratio, the spectrum of all the frequencies is decreased, which are also deduced from the sudden reduction of the rms of the pressure fluctuation. On the whole all the experimental results show that quite small displacement of the piezo actuator at the throat causes the large shock wave displacement and the large pressure fluctuations, which suggest the promising and potential application of the actuator to the noise reduction and to the high powered speaker if all the characteristic of the behavior of the shock wave and the flow are fully understood.

T-2E-4. INFLUENCE OF THE EXPANSION RATE OF NOZZLE ON TWO-DIMENSIONAL SUBSONIC JET

S. Y. SHIN, *Kyungpook National University*, *Korea*, S. H. KIM, *Kyungpook National University*, *Korea*, Y. D. KWON, *Kyungpook National University*, *Korea,* S. B. KWON, *Kyungpook National University*, *Korea,* From the view points of frequent applications in diverse industries such as a mixing augmentation scheme, an air knife system and so on, two-dimensional turbulent free jets issuing from a symmetrical constant expansion rate nozzle are studied by a numerical analysis and experiment. In numerical analysis, we used the commercial code of Fluent 6.0, and two-dimensional Navier-Stokes equation with standard k-ε model is used as governing equation. To calculate the dynamic viscosity of working fluid, the Surtherland equation is used, and the working fluid is air. In the case of the same nozzle stagnation condition and system external configuration, the influences of the nozzle expansion rate on the jet structures, the velocity distributions, the potential core width and length and the growth of half widths are investigated. In the measuring of velocity, we used a pressure measuring system made with a stainless string of 0.8mm in outer diameter. As results, in the potential core region, we can't find exactly the similarities in velocity with the variations of expansion rate of nozzle, while the similarity of velocity in the fully developed region exists. And, for the same nozzle stagnation conditions, we can’t find nearly the difference in potential core length with P. Furthermore, we can’t find the difference of velocity gradients in y direction at the potential core regions of the same x. Finally, it is found that the decay angle of potential core θ regardless of nozzle expansion rate is around of 5.0^o.

14:30 ~ 15:50 (Room 106)

Drops and Bubbles (II)

Session Chair : Prof. Mohammad Ali, BUET/Bangladesh

T-2F-1. MODELLING THE FORMATION OF A THERMAL SPRAY COATING USING A STOCHASTIC APPROACH

Mohammad P. FARD, Ali R. TEYMOURTASH and Ebrahim KAMALI, *Department of Mechanical Engineering, Ferdowsi University of Mashhad, Mashhad, Iran,* Thermal spray coating is a particulate deposition process in which powders of a material are injected into a high temperature flame region where they are melted and propelled towards the surface of a