

Colored helium bubble flow visualization control technology

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Abstract-In this paper, the basic understanding of the principles of flow visualization 0.75m × 0.75m backflow wind tunnel in the self-study colored helium bubble flow control device, observe the liquidity situation of the aircraft model in the low-speed state, and achieved good effect.

Keywords- *flowing display; eddy; color helium bubble*

I. OVERVIEW OF FLOW VISUALIZATION

Process visualization flow visualization technology task is to make the fluid transport phenomena. Through a variety of flow visualization experiments to understand the complex flow phenomena, to explore the physical mechanisms for people to discover new flow phenomena, an important means to create new concepts and provide the basis for the physical model, but also to solve practical engineering problems.

Flow visualization technology development with the development of fluid mechanics, has been 100 years of history. It can be said that the fluid dynamics in the development process, every major discovery in the academic and applied to the engineering of the actual almost from the observed flow phenomena began. Reynolds transition experiments; Mach shock wave phenomenon observed; Prantl metal powder tracer particles, a stream along the flat spectrum, proposed the concept of the boundary layer on the sink; V.Karman cylinder around flow observation and Karman Vortex street proposed; Detached eddy research; turbulent coherent structures in found type of proposed research and separation of the flow stream; separation at high angles of attack, and so on, are all based on flow visualization and measurement of out of body based on the results. In-depth analysis of the flow phenomena is to establish and validate new concepts, found the key to the new flow law.

Modern hydrodynamics and aerodynamics development as well as the separation of the flow pattern in the research and development of a new generation of aircraft, for people to complex flows (for example, separated flow, vortex flow, turbulence, unsteady flow, etc.) raised new issues including its mechanism and applied research. These complex flow generally is three-dimensional, unsteady, aperiodic pieces, coherent, and their behavior changes over time and space, or has a complex spatial structure, or the flow of non-steady, and often both. It should be pointed out that, since the capture of these complex flow phenomena and flow mechanism and the law is not enough research, including

one of the important reasons is the lack of a means of display and measurement of complex flow. Over the last decade, due to the urgent need of the engineering practice and modern optics, laser technology, computer technology, electronic technology,

information processing technology development, has brought vigor and vitality for flow visualization and measurement technology, especially in the display space flow and flow capacity of the internal structure of quantitative extraction as well as the flow of information and analysis at four aspects have made great progress, achieved a major breakthrough in the three-dimensional, unsteady complex flow quantitative measurement expect in the near future.

II. FLOW VISUALIZATION AND MEASUREMENT TECHNOLOGY

The range flow visualization and measurement methods, usually traditional flow visualization and measurement methods; computer-aided flow visualization and measurement methods (ie, flow visualization and measurement and computer image processing method of combining).

Taking into account the complex flow of aircraft development and other projects recognize the urgent need for and the huge advances in laser technology, computer technology, information processing technology, the produced particle image velocimetry (PIV), laser-induced fluorescence(LIF), laser molecular velocimetry(LMV), pressure-sensitive coating manometry (PSP) is a representative of the new generation of mobile measurement technology, they both the qualitative display and quantitative measurement ability, and some unsteady complex flow space transient structure display and measurement, so that the study of complex flow breakthrough progress.

A. *The basic principle of the color helium bubble flow visualization technique*

Helium bubble flow visualization is a space used in the wind tunnel flow visualization technology, helium bubble gun emission is not self-elevating helium bubbles in the upstream of the test model, these helium bubble down the river to bypass the model, its movement locus depicting the flow pattern around the model. Model painted a non-reflective dark, with a strong light source from the model downstream to upstream observation area irradiation

the strong helium speed of light bulbs white helium bubbles in the movement to form a white traces in dark black model and background can be observed in the backdrop of the flow pattern of the black-and-white around the model, you can use the camera or VCR recording equipment documented.

By optical interferometry helium bubble color, a color traces, more conducive to observation of flow phenomena. Helium bubbles film is thin, typically only 0.5 μ m to 1.0 μ m, and the membrane wall was space curved, uneven thickness distribution, and its difficult to form an interference, not all of the bubble membrane solution can appear colored For multicolored color helium bubbles, must be as wide as possible so that the wavelength range of the light source, the refractive index of the bubble film of light at a suitable value to color, but also to control the reflection angle of the film in a reasonable range, if the range is too big , will make the same bubble show different colors in different locations, and is difficult to distinguish the different traces.

This requires helium bubble gun, model and lighting arrangement and distance control properly, this is a technical problem. The requirements for the film thickness of the color helium bubble range as wide as possible, so that when the display test of the helium bubbles exist in different values, thereby to obtain a variety of colors in a - Instantaneous. Determined according to the principle of the test helium bubbles do not rise, not fall, the relationship between helium the pool film thickness and diameter, the wall thickness of the vesicle membrane control actually control the bubble diameter. By adjusting the air, helium and bubble film solution pressure or flow before the test, so that a reasonable match, need to get the wall thickness of the vesicle membrane.

B. Colored helium bubbles to show the basic device

Color helium bubbles show the Test device (Figure 1) is composed of three parts. The first part is helium bubble generating Equipment, including a helium gas source, the compressed air source, the liquid tank of the bubble membrane solution, the console, helium bubbles gun, etc.; second part is a light source Equipment, including a lighting fixture, a modulator, such as a Stand; The third part is a recording device, including cameras and recorders

The helium bubble gun is the key equipment in the test equipment. It consists of a nozzle head (see 1.6-4), opening and closing the valve and fairing like. The nozzle head is a core part of the helium bubble gun. The middle thin tube through the helium, the second layer of control, communications, bubble film solution, the outer tube through the compressed air. Middle fine works to form chlorine gas bubble, compressed air bubble from the tube ends stripped and blown out of the nozzle head. Rectifier gate for straight compressed air guide, guard in bubble generated and blowing process in the protective effect.

Helium foaming device by helium gas source, electronic micro-pumps, micro-adjustment device, oil-free air compressor.

Lighting, we selected the reflective stage Follow Spot Light , such lamps light field are hook, high intensity, you can adjust the focus and light bar. Higher light intensity of indium lamps can also be used, and configure four degrees of freedom of the stent, corresponding to a different the model attitude angle can adjust the orientation of the light beam, in order to obtain the best lighting effects.

Recording devices using a common high-resolution camera and video recorder. Photographic technology with monochrome color helium bubble helium bubbles similar, the difference lies in the control of color effect. Overexposed, the various colors of helium bubbles trace ordinary partial white underexposed traces unclear. Controlling exposure parameters primarily wind speed, instead of the shutter speed. Photographic wind election in more than 10m/s, wind speed is too low will be overexposed, wind speed greater than 30m/s difficult to clearly see the color helium bubbles flow around a trace. Strong light with the former, with the latter weak. Aperture/1. 2s and or 1/4s, the shutter speed is 1/4s or 1/8s.

III. CONCLUSION

The angle of attack of 14 ° edge of the vortex after paragraph and vortex flow pattern. As can be seen from the test photos, color helium bubble flow visualization technology has a higher resolution than monochrome helium bubble, different colors easily distinguishable, especially the more complex unsteady flow advantages.

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