The OpenUVP is ready to launch eUVP

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OpenUVP is preparing for a set of unit to be used for educational purpose and named *e*UVP. It consists of hardware-Pulsar/Receiver and software eUVP-TIT. As a whole set of educational equipment, two sets of desktop flow stand are prepared; pipe flow and a short column Taylor Couette Flow.

Keywords: OpenUVP, eUVP, desktop flow of Pipe flow and TCF.

1. Introduction

Activity of OpenUVP is progressed to prepare for the educational version of UVP – eUVP. Targeting its use in higher schools as technical school or engineering school on university level, simplicity of hardware and its use with standard PC is the most important factor for developing the system. Hardware to be developed consists of Pulsar /Receiver with ADC integrated and to be combined with PC. It was also designed to facilitate it for demonstration in the class room, not only in the flow lab, so that two standard flow configurations are prepared to be used on the class room table.

2. eUVP construction

2.1 Hardware – Pulsar/Receiver

Only hardware except transducers is a box with all necessary electronics integrated to work as UVP. It has two channels of Pulsar-Reciever system with ADC integrated. The system can be used for A and B mode operation of echo signal application. Raw echo signals are sampled and transferred to external PC with USB line.

2.2 Specification

The specification of the Pulsar/Receiver electronics is listed in the table below.

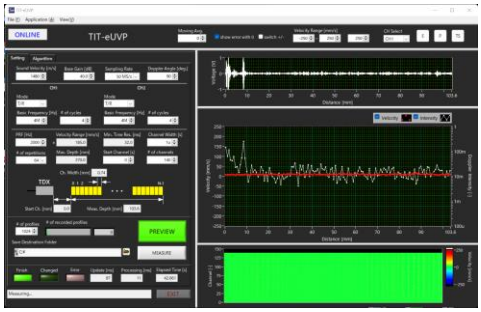
It can be operated with basic frequency from 0.5 to 10MHz.

All parameters can be controlled by the eUVP software externally. It has external triggering capability to be synchronized with PRF signal.

Parameter	Detail
Power source	100 to 230 VAC
Communication	USB 3.0
Interface	USB 3.0 (PC – TIT-eUVP) Transducer (BNC) ×2 CH Echo signal (BNC, 2 V_{p-p}) ×2 CH PRF trigger signal (BNC, 5 V TTL)
Number of transducer connection	2
Pulse voltage	150 V_{p-p}
Basic frequency	0.5 to 10 MHz (square burst wave)
Number of cycles	Up to 10
PRF	Up to 10 kHz
Echo signal gain	0 dB ~ 50 dB
Signal bandwidth	30 kHz to 12 MHz
A/D sampling speed / resolution	50 MS/s / 12 bit

2.3 Software – eUVP

eUVP software is prepared for using the PR exclusively for educational purpose using OpenUVP concept. It has two parameter panels – Parameter control panel and Measurement panel and three operational panels – Echo

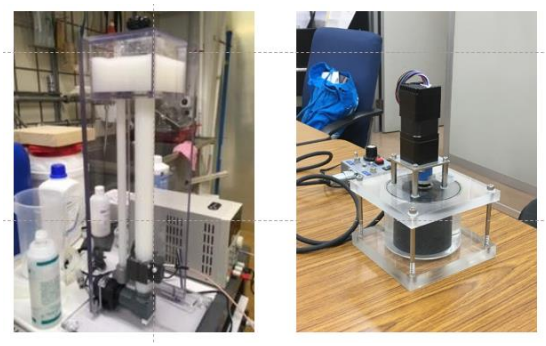


panel, Velocity profile panel and Color density panel – which are used to demonstrate a working style of UVP. Data set is stored in CSV format for reviewing and

analyzing measured results using any of external standard spread sheet applications.

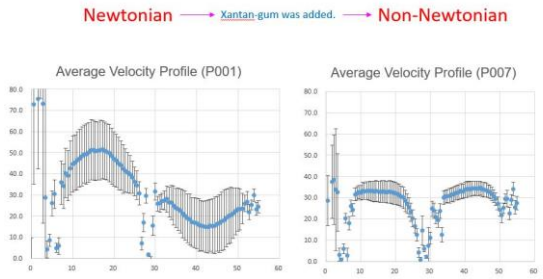
2.4 Desktop Flow models

In order for the apparatus to be used in normal class rooms, two sets of tabletop flow configurations are prepared – pipe flow and short column Taylor column.



2.4.1 Pipe flow

As UVP measures instantaneous velocity profile, pipe flow can be simple without flow development as is needed for standard pipe flow experiment. It consists of two straight pipe lines, one for measurement and another for return flow. The upper reservoir is easy to access to modify flow characteristics. By adding any viscous fluid a flow of Newtonian and non-Newtonian flow behavior can be tested. It can obviously catch data set for time averaged velocity profile to compare it with theory. By varying pump speed it is possible to show a change of velocity profile from laminar to turbulence.

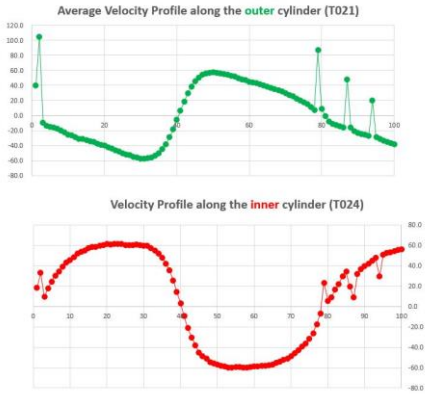


2.4.2 TCF

A short column Taylor Couette Flow (rotating double cylinder with only inner cylinder rotation) is prepared with aspect ratio of 2. This configuration is adequate to show that the flow velocity is vector. Measurement of z-component of vertical velocity as a function of z; Vz(z,t), at the inner and outer wall shows positive and negative velocity on one profile, which flips (change the sign) on the opposite wall position.

3. Lecturing eUVP with demonstration

As described above, eUVP is designed to be used in a class room environment by giving demonstration to students. Therefore eUVP software has the Echo panel to show the



echo signal as if on the oscilloscope screen. This is important since one shall know echography of ultrasound wave propagation, by which student shall see a beam behavior since it is invisible.

The main velocity profile panel is a movie screen where instantaneous profile is refreshed every measurement to show a movie. This could impress ones how real flow behavior is different from prior knowledge of fluid mechanics. In order to overview the total spatio-temporal behavior of the flow field, color density plot panel is provided so that typical characteristics of velocity field is visualized for better understanding and comparing with theoretical knowledge.

Flow models chosen here are designed so that student can play with it by themselves with monitoring the flow on the eUVP screen, This kind of interactive practice is the most effective way of teaching not only for understanding the most recent development of the experimenal technique - UVP - but also learning the nature of flow of liquid in various configurations.

4. Summary

The OpenUVP is ready to launch eUVP. Hardware is a Pulsar/Receiver designed for educational purpose. Software eUVP is prepared designed for classroom usage.

Two flow models are designed which needs no large equipment to make typical flow fields.

The units will be taken into the market in due course.

References

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