

Scientific FabLab at the Faculty of Mechanical Engineering University of Belgrade - Support for Experimental Fluid Flow Research

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Complex fluid flow phenomena, as well as energy and cavitation characteristics of hydraulic machinery and equipment are studied in the Laboratory for Hydraulic Machinery and Energy Systems, Faculty of Mechanical Engineering (FME), University of Belgrade (UB). Research in the Laboratory comprises micro to macro scales fluid flow research. In Laboratory exist installation for investigation of the energy and cavitation characteristics of turbine models (Francis, Kaplan, bulb), installation for research and visualization of the cavitation in pumps and on the hydroprofiles, installation for pump testing, educational-demonstrational set-up for testing hydraulic pump and Venturi flow meter calibration, installation for testing valves, four installations for volume flow calibrations: up to 10 l/min, 3 l/s, 50 l/s and 200 l/s, three installations for turbulent swirl flow investigations in air behind the axial fan impeller: in pipe, diffuser and jet, open wind tunnels for calibration of velocimetry probes: up to 10 m/s, 36 m/s and 60 m/s, and etc. In this lecture will be presented new results obtained in Laboratory, from idea, computer modelling and numerical simulation to realization of the experiments.

In Laboratory exist various measuring and calibration devices, as well as machining systems. Novel measurement systems would be presented: three-components LDV (laser Doppler velocimetry) system, stereo particle image velocimetry (SPIV), high speed SPIV, micro PIV, calibration of pressure devices with air and oil, and etc. Some results of laser based turbulent swirl flow research are presented. Complex experiments seek thorough preparations, so production capacities must occur in such a big laboratory. This is organized in the Laboratory workshop. CAD (the computer-aided design) 3D models are designed in various softwares. Two CNC (computer numerical controlled) machines are fully operational: 3+1-axis vertical machining centre (1016 x 508 x 635 mm), 5-axis vertical machining centre (1270 x 660 x 635 mm). In Laboratory many other machines exist, like vertical drilling machine, another milling machine, one lathe machine, and etc. Other complex machines exist in the Department for Production Engineering at FME UB. In addition, Printrobot Simple Metal 3D printer is also applied in the Laboratory. For collaboration with students, researchers and sophisticated industry, these capacities are organized in Scientific FabLab [1, 2].

Realization of ideas is encouraged in the Scientific FabLab. In fact, 3D model and production simulation software reveal all important points in ideas realizations. Student project - axial compressor blade could be printed and they can study geometry in vivo, not only by computer 3D model [3]. They can also print designed centrifugal pump impeller [4]. Production on CNC 3-axis machine of radial centrifugal impeller in duraluminium is presented in lecture, as well as designed mould for axial impeller blade [5]. Additional aspects of production of laboratory educational model and its integration in remote laboratory are also presented here [6]. In Laboratory is established procedure for repairing hot-wire anemometer (HWA) probes, with help of Prof. Dr Petar Vukoslavčević, University of Montenegro, Faculty of Mechanical Engineering. It is used for positioning and welding small sensors (2.5 microns or even lower in diameter) on the HWA probes prongs using stereo microscope and the original micro positioning device with fifteen degrees of freedom [7]. These HWA probes are afterwards used for turbulence measurements. In Laboratory are applied, as well as developed, novel measurement techniques. Technique and procedure for affordable and "do-it-yourself" PIV measurements are developed in Laboratory [8]. This technique is planned to be used for fluid flow research in micro channels [9]. Recent investigations are focused on micro channel manufacturing and some results will be presented [10-11]. In addition, acquired experience in knowledge dissemination through open access workshops will be introduced.

KEYWORDS

Hydraulic machinery, fluid flow research, scientific FabLab, production, measurements.

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