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PRESSURE-SENSITIVE PAINT (PSP) CALIBRATION STAND**

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Conventional methods of the surface pressure distribution measurement on blade cascades used pressure microtransducers. This called for a laborious technology of making both the pressure taps laid out on the blade surface and the system of ducts carrying the pressure signals to the transducers. In the case of rotating components the measurement got complicated further by a system feeding signals into an external data logger. Using non-invasive techniques is an alternative approach to such experimental testing. One of them is the method which has been developed worldwide for several years now, employing pressure-sensitive paints (PSP) [1], [3].

A typical layer of the PSP is composed of a luminophore (luminous particles) and a polymer binder. The binder has to be oxygen-permeable. The oxygen molecule gets excited by absorbing photons from an external source of excitation. The return from the excited state is accompanied by photon emission. If there are oxygen molecules nearby, a part of the energy may be given to them in the form of oscillations because oxygen molecules tend to suppress photon emission. At a higher pressure, more oxygen molecules participate in the suppression, which results in a change in luminous intensity. Luminous intensity is inversely proportional to air pressure exerted on the tested surface. The measurement concept is presented in Fig.1.

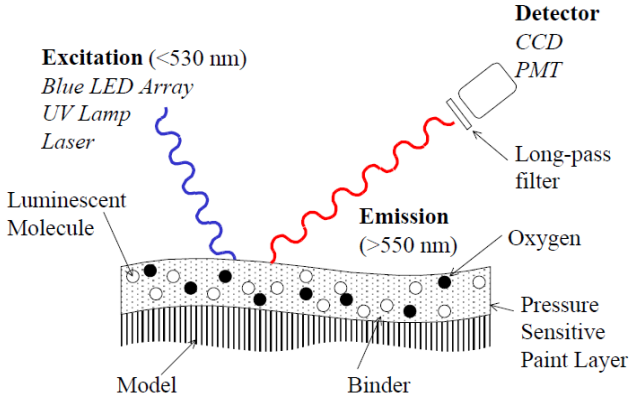

Fig. 1 The measurement concept by means of the PSP method.

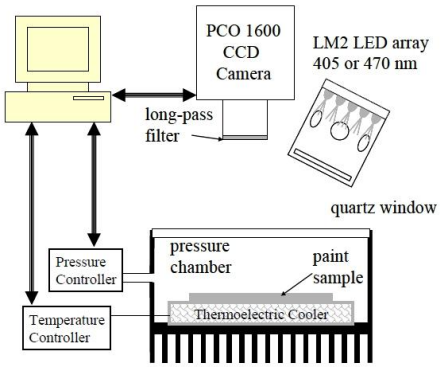

Fig. 2 The system for PSP calibration.

In the PSP method, the PSP calibration has to be carried out before the actual measurement. The calibration procedure is one of the problems related to PSP measurements because the method is not only pressure- but also temperature-sensitive [2].

This paper presents a PSP calibration system implemented at the Institute of Power Engineering and Turbomachinery of the Silesian University of Technology. A special calibration chamber (Fig. 3) is built to determine the recorded light luminous intensity as the function of pressure at different values of temperature and excitation luminous intensity.

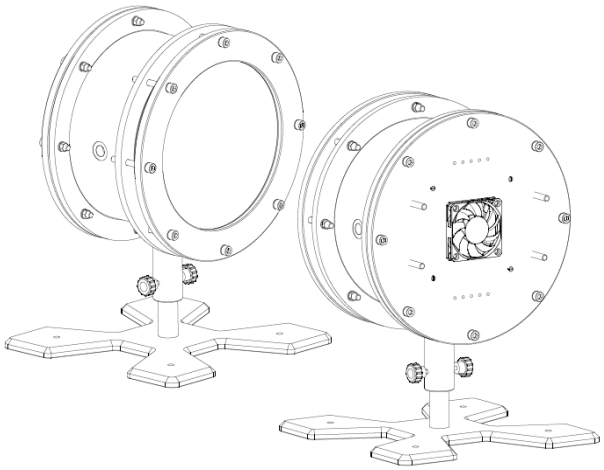

Fig. 3 The calibration chamber.

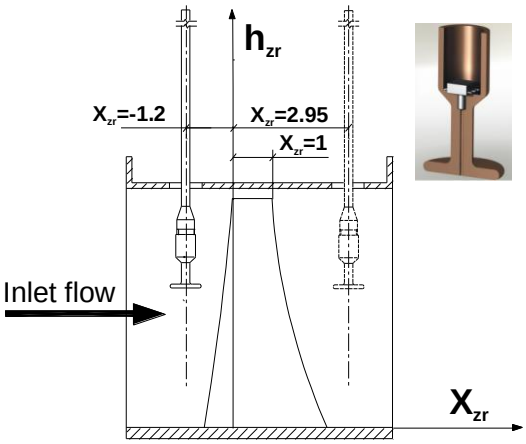

Fig. 4 The system for the verification of PSP calibration parameters.

The surface of the model rectangular plate is covered with pressure-sensitive paint and illuminated with an excitation light source with a wavelength below 530 nm (array of blue LEDs). The surface pressure field image is recorded with a CCD camera fitted with an optical filter which is permeable to radiation, emitted by luminescent PSP, with the length exceeding 550 nm.

Calibration is carried out for different values of temperature, pressure and excitation luminous intensity. Calibration plots are logged as parameters in the program for the analysis of the CCD camera image.

A preliminary verification of calibration carried out in this way is to be performed in a wind tunnel (modified axial compressor stage [4], [5]). An extra piece of information concerning the flow is obtained on the stand using a disc probe in the flow system as shown in Fig. 4.

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