5. Anemometer

1) First we need to find the angle after the refraction β: For small incidence angles we find approximately $\beta = \alpha/n$. In the liquid, the wavelength is decreased n times: $\lambda' = \lambda/n$. The requested wavelength can be found as the distance between the lines connecting the intersection points of the equal phase lines of the two beams. Alternatively (and in a simpler way), it is found as the difference of the two wavevectors: $k' = k\beta$, where $k = 2\pi/\lambda' = 2\pi n/\lambda$ is the wavevector of the incident beams. So, $\Delta = 2\pi/k' = \lambda/\alpha \approx 7{,}4\,\mu\text{m}$.

2) The scattered light fluctuates due to the motion of the scattering particles; the frequency is $\nu = v/\Delta = v\alpha/\lambda$. There is no way to determine the direction of the flow, but the modulus is obtained easily:

$$v = \frac{\nu\lambda}{\alpha} \approx 0.37\,\text{m/s}.$$

3) The spatial structure of the interference pattern remains essentially unchanged (the wavelength difference is negligible). However, the pattern obtains temporal frequency $\delta\omega = \delta(c/\lambda) \approx c\,\delta\lambda/\lambda^2$. The velocity of the interference pattern $u = \Delta\,\delta\omega = \frac{c}{\alpha}\frac{\delta\lambda}{\lambda}$. If the fluid speed is $v \approx 0.37\,\text{m/s}$, then the relative speed of the pattern and the fluid is $\nu' = \frac{c}{\alpha}\frac{\delta\lambda}{\lambda} \pm v$, depending on the direction of the flow (in both cases, $\nu' \approx 740\,\text{kHz}$). So, the output frequency allows us to determine the flow direction as long as we can be sure that the interference pattern velocity is larger than the flow velocity.