Experimental methods for the study of surface waves. Application to the streaming

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Recently two optical methods have been developed to reconstruct the topography of the free surface of a liquid. One of them - known as synthetic Schlieren [1] - is based on the refraction of light. For its implementation, a dot pattern randomly generated is placed at the bottom of the liquid layer. The deformation of the gas-liquid interface produces an apparent displacement of the dots, which is proportional to the gradient of surface deformation h (x, y). A second method - known as Fourier Transform Profilometry [2]- is based on the reflection of light. To use it, it is necessary to paint the liquid in such a way that diffuse reflection occurs on the free surface. Then a fringe pattern is projected on the free surface. The fringe pattern is recorded with a digital camera. In this case the deformation h (x, y) of the free surface is related to a phase difference. In this work these two methods are described and they are applied to the investigation of the streaming in surface wave. The streaming is different from the Stokes drift, although both are nonlinear phenomena in a fluid. In a recent paper by H. Punzmann et al [3] it is shown that the oscillatory motion of a solid object partially submerged in a liquid produces not only waves, but also a flow whose vorticity is different from zero. In this work we present experimental results of the wave and velocity fields produced by a parabolic wave maker that oscillates in the vertical direction [4]. Among others things, we found the formation of two recirculating cells formed on both sides of the symmetry axis. The existence of this velocity field will modify the shape of the wave fronts, if compared to the results obtained by the ray theory. One of the consequences is that the position of maximum amplitude of waves approaches the wave maker. Finally, we discuss the modification that this velocity field produces on the focusing of surface waves.

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