Measuring Water Waves

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When a water droplet impacts a surface of water, part of the drop disappears into the water, while the rest bounces out again. This fascinating process repeats itself several times in a fraction of a second. Since this process remains outside the capabilities of the human eye, it can only be viewed using very expensive high-speed cameras. However, tiny capillary waves, meaning waves determined by the surface tension of the water, are generated during the process. Therefore, the objective for my project was to develop an alternative measurement method that could be used to measure the heights of these waves in order to observe the water droplet indirectly as it breaks apart. A measuring principle based on the refraction of light has been theoretically devised. The refraction of a light beam at a water surface yields valuable information about the its inclination. Then a measuring device, containing a collimated, focused LED light source and a single-line-CCD-camera, was constructed. Higher camera frame rates are achieved by combining data of multiple experiments. By this simple means the apparatus can measure water waves caused by the coalescence cascade on a micron scale at an effectively twice as large frame rate. Further experiments and/or better equipment are needed to increase the time resolution to a level, where the partial coalescence cascade can be observed. Additionally the measuring device could also be used in other experiments such as the examination of the deformation of a water surface by a static object.

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Fourth Award of $500