Wave Animation Synthesis Directly from A Real Video

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Overview
In this sketch, a semi-automatic wave animation method/system is presented by a direct use of a real wave video with a modified optical flow method. Previous method: A realistic fluid-like animation such as river and ocean has become an intensive research topic. Various wave animation methods have been proposed based on wave generation theory [1]. [1] presented an energy spectrum based wave generation method. [2] applied [1]'s method to animate a harbor and river of an oil painting. Issue: These conventional methods for a natural scene needed to empirically define optimal parameters interactively. [1] shows a very realistical wave motion, though, deep knowledge of a wave property is needed. Using a random variable leads to a plausible wave motion but it is hard to control how such a wave activity shows. For an inexperienced user, a wave animation method should be hopefully much more simplified. Motivation: Thus, this was motivated us to propose a quick wave animation method using a real wave video. What a user needs is only to collect a wave video and then input it into our system. Our system: In our system, computer vision based optical flow and physical properties of a wave sequence is used to estimate parameters which are necessary for a wave generation equation over time. As shown in Figure 1, a user simply handles to select a wave video and press a start buttom to get an animation only by a mouse operation with a default rendering setting. Thus, a realistic wave motion similar to what a user wishes to animate can be synthesized almost automatically while above previous methods take a great effort and time.

Methods
Wave generation equation: In ocean engineering [3], it is well-known that a real wave behaves in a multidirectionality irregularity motion with a crest and trough. This has been modelled by a multiple combination of a sinusoidal wave generation equation (mSWG) with different many physical parameters such as frequency, amplitude, wavenumber, and phase. For synthesizing a wave, all of such parameters have to be predefined interactively. [1] showed how to reduce such parameters. However, an intuitive definition for some parameters was remained. Therefore, it was hard to match an animation with what a user looks at. Instead of using a spectrum energy model, we utilized a time-dependent SWG with above unknown physical parameters [3].

Modeling: Three wave image sequences of a real rough (Figure 2) and the other two forms were used in order to directly estimate above necessary parameters. A wave can create a complicated dynamic texture due to specularity, shadow, and white-cap under the sun. To ease this issue, we first assumed that a matching point between image frames exists when a sampling rate is very small. Thus, we have proposed an optical flow model integrated with a wave equation taking the first derivative with respect to time, leading to the objective function. Result: By minimizing this objective function, optical flow (Figure 3) and physical parameters can be estimated at the same time using every two consecutive images of a video. Thus from every frame pairs, except optical flow, wave related parameters which are applied to an mSWG can change over time. This can follow nonstationary phenomena in a video resulting in a nonperiodirical wave animation (Figure 4). It is noted that unlike previous method [1] no ramdom parameters were applied to create such a rough water surface. Instead, different physical parameters were provided in two dimension from images and applied. Rendering by MAYA™, plausible wave animations (Figure 5) have been synthesized directly from a rough wave image (Figure 2) and the other moderate and smooth wave image sequences (not shown here).

Conclusion
A quick wave animation method from a real wave video has been addressed. Owe to this, every user can create a realistic wave motion by simply choosing a real wave scene what a user viewed.

References