Motion Texture Animation of Water Surface

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1 Introduction

We present a new method for making wave animation from still water image. In our method, users can control the behavior of wave in the water surface intuitively and interactively. After we simulate the wave using a Spectral Method [Tessendorf 1999], we have the water surface corresponding to the projection system of static images. Previous works for animating water surface. Chuang *et al* [Chuang and Goldman 2005] proposed a method for generating an animating of picture using displacement mapping and warping, however, those methods are only effective for gentle and calm water surfaces. Contrarily, our method is adaptively used for large scale waves of water height field.

2 Our Method

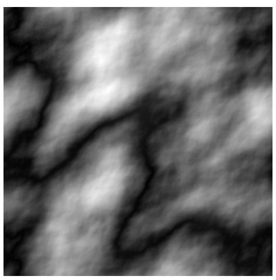

Figure 1:Height Field

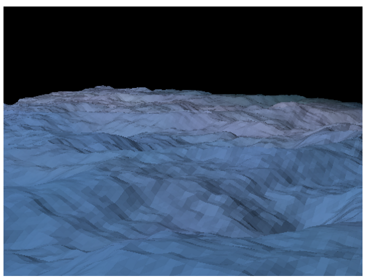

Figure 2: 3D Water Surface

Our method has two major steps to create the dynamic wave animation for static images. At the first step, we simulate the plausible motion of water surface and wave in real time by Spectral Method. At the second step, we match the parameters of water surface and static images of water surfaces.

2.1 Simulating Water Surface

We use Spectral Method [Tessendorf 1999] to simulate the water surfaces and waves. The spectrum filter $P_h(\mathbf{k})$ which is based on a statistical models of wind speed $\mathbf{V}$ and direction $\hat{w}$, is given as formula (1).

$$P_h(\mathbf{k}) = A\frac{\exp(-1/(kL)^2)}{k^4}|\hat{\mathbf{k}} \cdot \hat{w}|^2 \quad (1)$$

where $L = \frac{\mathbf{V}^2}{g}$, k, A are spatial frequencies constant coefficients. By using this filter and formula (2), we can generate height field of water surfaces as seen from Figure 1.

$$\tilde{h}_0(\mathbf{k}) = \frac{1}{\sqrt{2}}(\xi_\mathrm{r} + i\xi_\mathrm{i})\sqrt{P_h(\mathbf{k})} \quad (2)$$

where ξ_r and ξ_i are gaussian ramdom numbers, respectively. From the obtained height field, we can create 3D waving water surfaces illustrated in Figure 2. We also give wind parameters by using mouse operations which determines the behavior of waves. This allows users to specify the direction and speed of water surfaces intuitively and interactively.

2.2 Matching to Images

The water surface model is projected to target picture's geometry. First, water area is manually cropped by user. Next, we composite generated 3D water surface meshes into the image. Texture mapping method is used to produce plausible rendering of surfaces.

3 Result

Figure 3:Target Image

Figure 4: Result Image

Figure 4 illustrates an obtained image by using our method. This choppy lake image(Figure 4) was generated from a calm lake image(Figure 3). It is also possible to control a state of water surface in a still image with wind speed by mouse drag distance and wind direction as the user inputs direction of wind in real time. We have used Intel(R) Core(TM) 2 Quad CPU 2.66GHz, 2GB memory as spec of PC. This example was animated with 10 frames per second.

4 Conclusion

We proposed a method for generating waving water surface animation for still images. First, we modeled 3D water surfaces using Spectrum Method. Second, we fitted 3D water surfaces into target still image by projection geometry. Finally, we added 3D water surface images onto target image and succeeded to animate water surfaces in the still image. Our method can be used to generate dynamic wave animations from a still image. In the future work, we are planning to design automatic algorithm which projects geometry to render optical realistic scenes.

References

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TESSENDORF, J. 1999. Simulating Ocean Water. *SIGGRAPH Simulating Nature Realistic and Interactive Techniques Course Notes*, 47.

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