

Modeling and Visualization of a Pearl: Towards Representation of Essential Quality

†Noriko Nagata, ††Toshimasa Dobashi, ††Yoshitsugu Manabe, †Teruo Usami, and ††Seiji Inokuchi

†Industrial Electronics & Systems Laboratory,
Mitsubishi Electric Corporation,
8-1-1 Tsukaguchi-honmachi, Amagasaki, 661 Japan
Phone: +81-6-497-7649
Fax : +81-6-497-7728
E-mail: {nagata, usami}@con.sdl.melco.co.jp

††Department of Systems Engineering,
Osaka University,
1-3 Machikaneyama-cho, Toyonaka, 560 Japan
Phone: +81-6-850-6370
Fax : +81-6-850-6341
E-mail: dobashi@inolab.sys.es.osaka-u.ac.jp,
{manabe, inokuchi}@sys.es.osaka-u.ac.jp

ABSTRACT

Visual simulation using CG and VR has attracted wide attention in machine vision. This paper proposes a method of modeling and visualizing pearls that will be the central technique of a pearl quality evaluation simulator. Pearls manifest a very specific optical phenomenon that is not dependent on the direction of the light source. To investigate this feature, we propose a physical model for multilayer film interference considering the multiple reflection in spherical bodies. The rendering algorithm has been configured from such representations of physical characteristics as interference, reflection and texture which correspond respectively to the sense of depth, brightness and grain that are the main evaluation factors obtained from psychological experiments. Further, in the process of image generation a psychological scale of essential quality of pearl we call the "pearl-like quality" is configured from portions of photos of real pearls. The images generated by the present method were evaluated based on a scale of psychological evaluation of "pearl-like quality" demonstrating thereby that not merely the generated images as a whole but the respective parts of images can present such essential quality of pearl.

Keywords— Quality evaluation, physics-based modeling, multilayer film interference, psychological scaling, computer graphics, inspection of pearl.

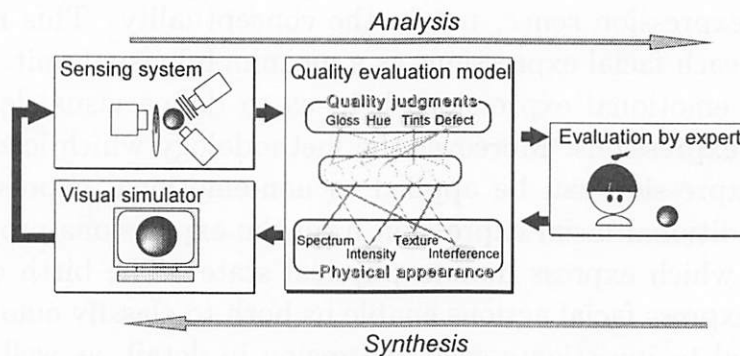


Fig. 1 Process of building up a pearl quality evaluation system by analytical and synthetic approach.

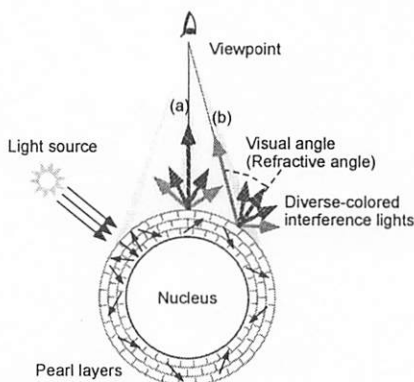


Fig. 3 Physics model of multilayer thin films of pearl.



Fig. 9 Superimposition of the synthesized image on a photo of real pearls. A synthesized image (left) and a real pearl (right).