Radioptimization — Goal Based Rendering

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Abstract

This paper presents a method for *designing* the illumination in an environment using optimization techniques applied to a radiosity based image synthesis system. An optimization of lighting parameters is performed based on user specified constraints and objectives for the illumination of the environment. The system solves for the "best" possible settings for: light source emissivities, element reflectivities, and spot light directionality parameters so that the design goals, such as to minimize energy or to give the the room an impression of privacy, are met. The system absorbs much of the burden for searching the design space allowing the user to focus on the goals of the illumination design rather than the intricate details of a complete lighting specification. A software implementation is described and some results of using the system are reported.

The system employs an object space perceptual model based on work by Tumblin and Rushmeier to account for psychophysical effects such as subjective brightness and the visual adaptation level of a viewer. This provides a higher fidelity when comparing the illumination in a computer simulated environment against what would be viewed in the "real" world. Optimization criteria are based on subjective impressions of illumination with qualities such as "pleasantness", and "privateness". The qualities were selected based on Flynn's work in illuminating engineering. These criteria were applied to the radiosity context through an experiment conducted with subjects viewing rendered images, and the respondents evaluated with a Multi-Dimensional Scaling analysis.