Interactive Stable Ray Tracing
Interactive ray tracing applications running on commodity hardware can suffer from objectionable temporal artifacts due to a low sample count. We introduce stable ray tracing, a technique that improves temporal stability without the over-blurring and ghosting artifacts typical of temporal post-processing filters. Our technique is based on sample reprojection and explicit hole filling, rather than relying on hole-filling heuristics that can compromise image quality. We make reprojection practical in an interactive ray tracing context through the use of a super-resolution bitmask to estimate screen space sample density. We show significantly improved temporal stability as compared with supersampling and an existing reprojection technique. We also investigate the performance and image quality differences between our technique and temporal antialiasing, which typically incurs a significant amount of blur. Finally, we demonstrate the benefits of stable ray tracing by combining it with progressive path tracing of indirect illumination.
estimate optical properties, and to develop our method for scene reassembly.

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Interactive Appearance Prediction for Cloudy Beverages

Juice appearance is important to consumers, so digital juice with a slider that varies a production parameter or changes juice content is useful. It is however challenging to render juice with scattering particles quickly and accurately. As a case study, we create an appearance model that provides the optical properties needed for rendering of unfiltered apple juice. This is a scattering medium that requires volume path tracing as the scattering is too much for single scattering techniques and too little for subsurface scattering techniques. We investigate techniques to provide a progressive interactive appearance prediction tool for this type of medium. Our renderings are validated by qualitative and quantitative comparison with photographs. Visual comparisons using our interactive tool enable us to estimate the apple particle concentration of a photographed apple juice.

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Interactive directional subsurface scattering and transport of emergent light

Existing techniques for interactive rendering of deformable translucent objects can accurately compute diffuse but not directional subsurface scattering effects. It is currently a common practice to gain efficiency by storing maps of transmitted irradiance. This is, however, not efficient if we need to store elements of irradiance from specific directions. To include changes in subsurface scattering due to changes in the direction of the incident light, we instead sample incident radiance and store scattered radiosity. This enables us to accommodate not only the common distance-based analytical models for subsurface scattering but also directional models. In addition, our method enables easy extraction of virtual point lights for transporting emergent light to the rest of the scene. Our method requires neither preprocessing nor texture parameterization of the translucent objects. To build our maps of scattered radiosity, we progressively render the model from different directions using an importance sampling pattern based on the optical properties of the material. We obtain interactive frame rates, our subsurface scattering results are close to ground truth, and our technique is the first to include interactive transport of emergent light from deformable translucent objects.
VirtualTable: a projection augmented reality game

VirtualTable is a projection augmented reality installation where users are engaged in an interactive tower defense game. The installation runs continuously and is designed to attract people to a table, which the game is projected onto. Any number of players can join the game for an optional period of time. The goal is to prevent the virtual stylized soot balls, spawning on one side of the table, from reaching the cheese. To stop them, the players can place any kind of object on the table, that then will become part of the game. Depending on the object, it will become either a wall, an obstacle for the soot balls, or a tower, that eliminates them within a physical range. The number of enemies is dependent on the number of objects in the field, forcing the players to use strategy and collaboration and not the sheer number of objects to win the game.