Seamless Integration of Real and Virtual Environments

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Within the field of augmented reality there are a number applications already available which allow for physical interaction between a real scene and certain virtual objects. Often times though this interaction is quite limited and coarse in detail. The objective of this dissertation is to design and create a model which allows for detailed and accurate physical interaction between a real scene and various virtual physical phenomenon. In particular, we wish to be able to expose virtual objects such as rigid bodies, cloth and fluid to a view of a real scene and have them behave like they belong in this scene. To achieve this, the Microsoft Kinect is used to scan in information about the real scene and Kinect Fusion is used to track the motion of the camera and build a fully volumetric 3D representation of the scene. The physically relevant information is extracted from the scene and a unified particle solver is then used to simulate the physical interactions. The results presented far surpass the capabilities of current alternatives found in games today and real-time performance is maintained by executing nearly everything on the GPU.