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A Survey of Real-time Crowd Rendering

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In this survey we review, classify and compare existing approaches for real-time crowd rendering. We first overview character animation techniques, as they are highly tied to crowd rendering performance, and then we analyze the state of the art in crowd rendering. We discuss different representations for level-of-detail (LoD) rendering of animated characters, including polygon-based, point-based, and image-based techniques, and review different criteria for runtime LoD selection. Besides LoD approaches, we review classic acceleration schemes, such as frustum culling and occlusion culling, and describe how they can be adapted to handle crowds of animated characters. We also discuss specific acceleration techniques for crowd rendering, such as primitive pseudo-instancing, palette skinning, and dynamic key-pose caching, which benefit from current graphics hardware. We also address other factors affecting performance and realism of crowds such as lighting, shadowing, clothing and variability. Finally we provide an exhaustive comparison of the most relevant approaches in the field.

http://dx.doi.org/10.1111/cgf.12774

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