Shadow Volume

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# What is it

First proposed in 1977 by Frank Crow, Shadow volume describes the 3d shape of the region occluded from a light source. A shadow volume divides the virtual world into two areas, those that are in shadow and areas that are not.

This technique was discovered by William Bilodeau and Michael Songy in 1998 and was eventually popularized by John Carmack in his Doom 3 engine (2002). The stencil buffer implementation of shadow volumes is considered one of the better practical general purpose real-time shadowing techniques used on modern 3D graphics hardware.

Shadow Volume works by creating a mesh that is constructed by extruding volume of an object away from a light source, with only the silhouette edges of the object as seen by the light source actually being extruded.

The key idea is that when an object is inside the volume (and therefore in shadow) the front polygons of the volume win the depth test against the polygons of the object and the back polygons of the volume fail the same test. Then a full screen shadow colour can be blended over the shadowed pixels (or alternatively a full screen lighting shader can be rendered over pixels *not*in shadow).

## Advantages and Disadvantages Advantages

* Main advantage is the shadows being Pixel Perfect – no artefacts when screen resolution and shadow resolution are not in sync
* Capable of point light sources without modification (unlike shadow mapping)

## Disadvantages

* Shadow Volume techniques require the creation of shadow geometry which has the potential to be CPU intensive, depending on the implementation.
* shadow mapping is often faster
* Constructing the extruded edge mesh takes time, and must be done for every frame, for every shadow-casting object, for every light source. It also tends to negatively affect fillrate since it has to render many pixels across the screen multiple times into the stencil buffer.
* Shadow Volumes become increasingly expensive as the geometric complexity increases.
* The rendering of the volumes can be expensive as the cast polygons can be piled up on top of each other, creating large amounts of overdraw.
* Shadow volumes create a precise hard-edged shadow; however, reportedly many artists may prefer something softer or less precise
* Transparent items can mess up the algorithm without special care.