# Shadow Map Silhouette Revectorization

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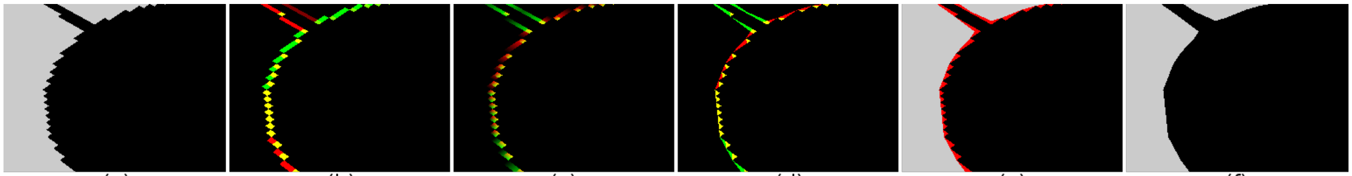


**Figure 1:** *From left to right, revectorization process. (a) Umbra exhibits perspective aliasing. (b) Discontinuity compression. (c) Orientated Normalized Discontinuity Space (ONDS) - a 2D xy-coordinate space between 0 and 1. (d) Clipped ONDS. (e) Red indicates new umbra surface which is going to be merged with existing lighting data. (f) Umbra after SMSR filtering pass.*

## Abstract

Shadow Map Silhouette Revectorization (SMSR) is a two-pass filtering technique inspired by Jorge Jimenez's MLAA [Jimenez et al. 2011] which aims to improve the visual quality of a projected shadow map by concealing the perspective aliasing with an additional umbra surface. In most cases undersampled areas result in a higher shadow silhouette edge quality. However, the technique is relatively new and has considerable room for improvement.

**Keywords:** shadow mapping, projection aliasing, real-time.

## 1 Introduction

Shadow mapping [Williams 1978] is known for its compatibility with rendering hardware, low implementation complexity, scalability and the ability to handle any kind of geometry. However, aliasing is a very common problem in shadow mapping. Projection, perspective [Lloyd et al. 2008] and temporal (flickering) aliasing are the three main discontinuity types which deteriorate the projected shadow map quality.

SMSR is based on the idea to reduce the perceptual error [Lopez-Moreno et al. 2010] by concealing the visible perspective aliasing around the shadow silhouette edge.

## 2 Implementation

The technique consists of two fullscreen passes and requires access to the camera view depth buffer, shadow map, lighting buffer, camera projection matrix and light view matrix.

The first pass searches for the exterior side of the shadow silhouette edge and compresses the relative edge discontinuity directions into a 2-component output vector (Figure 1b).

Based on the compressed discontinuity, the second pass searches in both directions along the current discontinuity axis for the discontinuity length and discontinuity end (interruption of initial discontinuity on the same axis).

After finding the discontinuity length and discontinuity end, the Orientated Normalized Discontinuity Space (ONDS, Figure 1c) can be constructed. By matching a correct clipping function, ONDS is clipped into a new shadow silhouette edge (umbra) and merged with the existing lighting data (Figure 1e).

## 3 Future Work

Shadow Map Silhouette Revectorization effectively reduces the perceptual error by concealing the perspective aliasing of an undersampled shadow map area. Unfortunately projection and temporal aliasing remain unhandled.

By saving the triangle edge data into the shadow map sample [Pan et al. 2009], it's possible to approximate a more accurate shadow silhouette edge and at the same time to reduce the temporal aliasing.

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## References

JIMENEZ, J., MASIA, B., ECHEVARRIA, J. I., NAVARRO, F., AND GUTIERREZ, D. 2011. *GPU Pro 2*. AK Peters Ltd., ch. Practical Morphological Anti-Aliasing.

LLOYD, D. B., GOVINDARAJU, N. K., QUAMMEN, C., MOLNAR, S. E., AND MANOCHA, D. 2008. Logarithmic perspective shadow maps. *ACM Trans. Graph. 27*, 4 (Nov.), 106:1–106:32.

LOPEZ-MORENO, J., SUNDSTEDT, V., SANGORRIN, F., AND GUTIERREZ, D. 2010. Measuring the perception of light inconsistencies. In *Symposium on Applied Perception in Graphics and Visualization (APGV)*, ACM Press.

PAN, M., WANG, R., CHEN, W., ZHOU, K., AND BAO, H. 2009. Fast, sub-pixel antialiased shadow maps. *Comput. Graph. Forum 28*, 7, 1927–1934.

WILLIAMS, L. 1978. Casting curved shadows on curved surfaces. In *SIGGRAPH'78 Proceedings*, ACM, 270–274.

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