

Addendum to the book “Shadow Algorithms Data Miner”

Preface

We were originally going to list all the patents (that we know of) on shadow algorithms as part of the discussion in the book. We thought this would be a useful service to the reader. However, in better understanding the patent policy of certain companies, this service may turn into a disservice. As a result, we have removed such a list from the book, and the references to patents and their implications are entirely removed from the book. If the reader is interested in such a patent list as well as how the patents have affected the literature and adoption, we provide the reader this addendum if he/she wants it. Enjoy!

Andrew and Pierre

Patent List

Here is a list of referenced work in this book that is patented (or patent pending), that we are aware of. Note that all references in numbers (e.g. [50]) indicate references that were both published as papers as well as patents:

- **Shadow volumes:** z-fail shadow volumes on the GPU [50], memory caching [Hakura07].
- **Shadow depth map:** avoid self-shadowing [Snyder99], dual-depth shadow depth maps on the GPU [167], opacity shadow map [304], trapezoidal shadow map [386], omni-directional shadow map [307], convolution shadow map [11], exponential shadow map [13], one specific partitioning approach to cascaded shadow map [335], miscellaneous [Foran98,Komsthoeft03,Peng03].
- **Ray tracing:** stochastic sampling [108] (though we suspect this patent may have expired), GPU k-d tree ray tracing [Zhou10a], ray tracing multilayer transparent shadow maps [649].
- **Other geometry types:** voxels [323,44], height fields [547], point cloud (surfels) [459].
- **Others:** motion blur [Pearce98], GPU projection textures [Gardiner99], GPU horizon mapping [538], single pass shadow computations [Zhou04].

Bibliography and Implications of the Literature + Adoption

[11] T. Annen, T. Mertens, P. Bekaert, H.P. Seidel, J. Kautz, "Convolution shadow maps", Rendering Techniques 2007: Eurographics Symposium on Rendering, June 2007, pp. 51-60. Also patented as "Method and device for generating shadow maps". **This is referenced in section 2.3.6 of the book.**

[13] T. Annen and T. Mertens and H.P. Seidel and E. Flerackers and J. Kautz, "Exponential shadow maps", Proceedings of Graphics Interface, pp. 155-161, May 2008. Also patented as "Method and device for generating shadow maps". **This is referenced in section 2.3.6 of the book. We suspect variance shadow**

mapping has gotten more adoption over exponential shadow maps is because exponential shadow maps are patented.

[44] U. Behrens and R. Ratering, "Adding Shadows to a Texture-based Volume Renderer", Proceedings of IEEE Symposium on Volume Visualization, pp. 39-46, October 1998. Also patented as "Processing Volumetric Image Data with Shadows", US Patent 6771263, August, 2004. **This is referenced in section 3.7.3 of the book.**

[50] B. Bilodeau and M. Songy, "Real Time Shadows", Creativity (Creative Labs Inc. Sponsored game developers conferences), May 1999. Also patented as "Method for rendering shadows using a shadow volume and a stencil buffer", US Patent 6384822, 2002. **This is referenced in section 2.4.2 of the book. We suspect it took Google Sketchup so long to fix their shadow volume bug is because they are trying to avoid this patent.**

[108] R. Cook and L. Carpenter, "Distributed Ray Tracing", Proceedings of SIGGRAPH, 18(3), pp. 109-115, July 1984. Also patented as "Pseudo-random point sampling techniques in computer graphics", US Patent 4897806, January, 1990. **This is referenced in section 4.7.1 of the book. The discussion of deterministic sampling approaches is a way to circumvent the stochastic sampling nature of the patent.**

[167] C. Everitt, "Interactive Order-Independent Transparency", NVIDIA Corporation, May 2001. Also patented as "System and method for dual-depth shadow-mapping", US Patent 6704025, March, 2004. **This is referenced in section 2.3.4 of the book.**

[Foran98] J. Foran and R. van Widenfelt, "Method and Apparatus for Shadow Generation Through Mapping", US patent 5742749, April 1998. **This would have been referenced in section 1.3.2 of the book.**

[Gardiner99] H. Gardiner, "Method for Rendering Shadows on a Graphical Display", US Patent 5870098, February 1999. **This would have been referenced in section 2.6 of the book.**

[Hakura07] Z. Hakura, "Method and apparatus to accelerate rendering of shadow effects for computer-generated images", US patent 7248261, July 2007. **This would have been referenced in section 2.4 of the book.**

[34] T. Kim and U. Neumann, "Opacity Shadow Maps", Eurographics Workshop on Rendering, pp. 177-182, 2001. Also filed as US patent pending #3208. **This is referenced in section 5.5 of the book. Since section 5.5 is mostly about variations of opacity mapping, it would not be surprising if adoption would be slowed due to this patent.**

[307] G. King and W. Newhall, "Efficient Omnidirectional Shadow Maps", Wolfgang River Media, pp. 435-448, 2004. Also patented as US Patent (6876362), "omnidirectional shadow texture mapping". **This is referenced in section 2.3.1 of the book.**

[Komsthoeft03] M. Komsthoeft and M. Ockenden and Y. Yasumoto and K. Hirose, "Shadow mapping in a low cost graphics system", US patent 6664962, December 2003. **This would have been referenced in section 1.3.2 of the book.**

[323] P. Lacroute, "Fast Volume Rendering using a Shear-Warp Factorization of the Viewing Transformation", Ph.D. Thesis, Stanford University, 1995. It may be patented. **This is referenced in section 3.7.2 of the book.**

[335] A. Lauritzen and M. Salvi and A. Lefohn", "Sample distribution shadow maps", ACM Symposium on Interactive 3D Graphics and Games, pp. 97-102, 2011. It has been applied for patenting (patent pending). **This is referenced in section 2.3.7 of the book.**

[386] T. Martin and T. Tan, "Anti-aliasing and Continuity with Trapezoidal Shadow Maps", Eurographics Symposium on Rendering, pp. 153-160, 2004. It may be patented. **This is referenced in section 2.3.7 of the book.**

[Pearce98] A. Pearce and K. Sung, "Analytic Motion Blur Coverage in the Generation of Computer Graphics Imagery", US Patent 5809512, September 1998. **This would have been referenced in section 5.7 of the book. To reduce storage, it would be interesting to consider an analytic motion blur coverage solution [Pearce98] in the shadow domain to be embedded in the deep shadow map beams.**

[Peng03] L. Peng and W. Donovan, "System, method and article of manufacture for shadow mapping", US patent 7119806 (and predecessor 6690372), September 2003. **This would have been referenced in section 1.3.2 of the book.**

[459] H. Pfister and M. Zwicker and J. van Baar and M. Gross, "Surfels: Surface Elements as Rendering Primitives", Proceedings of SIGGRAPH, pp. 335-342, July 2000. Also patented as "Method for Rendering Graphical Objects Represented as Surface Elements", US Patent 6,448,968, September, 2002. **This is referenced in section 3.6.3 of the book.**

[538] P. Sloan and M. Cohen, "Interactive Horizon Mapping", Eurographics Workshop on Rendering, pp. 281-286, June 2000. Also patented as US patent 7102647. **This is referenced in section 5.2 of the book.**

[Snyder99] J. Snyder and J. Kajiya and S. Gabriel and M. Toelle, "Method and System for Improving Shadowing in a Graphics Rendering System", US Patent 5870097, February 1999. **This would have been referenced in section 2.3.4 of the book. It looks like Snyder et. al, and Weiskopf and Ertl (as mentioned in the book) independently came up with the same alternate z-depth approach.**

[547] J. Snyder and D. Nowrouzezahrai, "Fast soft self-shadowing on dynamic height fields", Eurographics Symposium on Rendering, pp. 1275-1283, June 2008. Applied for patenting (20090309877) as "Soft Shadow Rendering". **This is referenced in section 3.8.2 of the book.**

[649] F. Xie and E. Tabellion and A. Pearce, "Soft shadows by ray tracing multilayer transparent shadow maps", Eurographics Symposium on Rendering, pp. 265-276, 2007. Also patented as US patent 7969438. **This is referenced in section 5.4.2 of the book.**

[Zhou04] H. Zhou and I. Konstantine, "Shadow rendering system and method", US patent 6791544 (and follow-up 7158133), September 2004. **This would have been referenced in section 2.6 of the book.**

[Zhou10a] K. Zhou and H. Qiming and G. Guo, "Ray tracing on graphics hardware using kd-trees", US patent 20100079451, April 2010. **This would have been referenced in section 2.5.2 of the book.**