

Parallel Marching Method on NVidia's GPU*

User Manual

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Abstract

This document describes the technical details needed in order to use the PMM package. An implementation of the "Parallel Marching Method" on NVIDIA's GPU. For algorithmic details please refer to: "Parallel algorithms for approximation of distance maps on parametric surfaces", published by: Ofir Weber, Yohai S. Devir, Alex M. Bronstein, Michael M. Bronstein and Ron Kimmel. ACM Trans. on Graphics 27(4). Presented at Siggraph 2008.

*Commercial use is not allowed - Patent Pending

1 System Requirements

1. Windows XP
2. NVIDIA's GTX 8800 GPU
3. CUDA 2.0 Toolkit
4. CUDA 2.0 SDK
5. CUDA supported display driver
6. Glut
7. Glew
8. Matlab
9. Environment variable \$ MATLAB_PATH (e.g. \$ MATLAB_PATH = "C:\Program Files\MATLAB71")
10. Environment variable \$ CUDA_SDK (e.g. \$ CUDA_SDK = "C:\Program Files\NVIDIA Corporation\NVIDIA CUDA SDK")

1.1 Notes

- The code is performance-tuned for NVIDIA's GTX 8800 GPU
- Other configurations may work but may lead to unpredicted results

2 Supported File Format

Each dimension of the grid should be a multiple of 32. - Smallest grid supported is 64x64 - Width and Height doesn't need to be equal - The file format is standard .Mat - Matlab binary file format. The file should contain the following variables:

1. X, Y, Z - 2D matrices with equal dimensions which represent a parametric surface.
2. x, y - 1D vectors with equal dimensions which holds the location of the source points.
3. V - 1D vectors with same dimension as x and y. It contains the initial value at the sources.

In order to mask out certain regions (e.g. holes) in the geometry image, one should use Matlab 'Inf' rather than arbitrary large positive number.

3 Package Components

The package contains 4 different components:

1. PMMLIB.lib - the core library of the PMM algorithm. The CudaWrapper.h header files exposes the functionality of the library to external applications. Source Code is not available.
2. PMM - a command line tool for computing geodesic distances. This application relies on the PMMLIB.lib library. Source Code is available and can be served as an example of how the library should be used.

3. PMMUI - a simple application with graphic user interface. This application relies on the PMMLIB.lib library. The application enables the load/save of .mat files and enables the user to dynamically change the sources locations in the parametric space and see the results interactively in real time.
4. PMM3D - an application with 3D graphic user interface. This application adds more functionality to the basic PMMUI application. It enables 3D viewing of huge models with millions of polygons. The user can pick the sources locations directly on the 3D model.

3.1 PMMLib - Library

The package contains the following two files:

1. PMMLIB.lib - a library for computing geodesic distances using CUDA.
2. CudaWrapper.h - header file containing the exposed functionality of the library.

3.2 PMM - Command line application

Usage:

PMM.exe [-nitters=N] -filename="path\filename"

- -nitters - number of iterations to perform (default is 1 iteration)
- -filename - path name of .mat (Matlab) file that contains the parametric surface and a list of source points

usage example: PMM -nitters=3 -filename="..\Matlab\surface.mat"

3.3 PMMUI - Graphics application

Mouse use:

- Left click - to add another source to the Geodesic Voronoi Diagram
- Right key + drag - to change the location of the nearest source point constantly

Keyboard use:

- 'C' - Toggle view between contoured and grayscaled distance map
- 'R' - Reset - clear all source points
- '+' - Increase the number of iterations (each iteration composed of scans in all 4 directions)
- '-' - Decrease the number of iterations (each iteration composed of scans in all 4 directions)
- '0'-'9' - Set the number of iterations to perform
- 'O' - Open .mat file containing the geometry of a parametric surface and source points
- 'S' - Save distance map to .mat file
- 'F' - Toggle between Bilinear and Nearest Neighbor filter mode display mode for magnification.

3.4 PMM3D - Graphics application

Mouse use:

- Left click - to add another source to the Geodesic Voronoi Diagram
- Right key + drag - to change the location of the nearest source point constantly
- Alt + Left key + drag - 3D rotation of the model
- Alt + middle key + drag - 3D translation of the model
- Alt + Right key + drag - 3D scale of the model

Keyboard use:

- 'C' - Toggle view between contoured and grayscaled distance map
- 'A' - Toggle auto rotation animation
- 'K' - Toggle auto scale animation
- 'R' - Reset - clear all source points
- 'U' - Show parametrization space - selection is done on the uv plane rather on the 3D model
- '+' - Increase the number of iterations (each iteration composed of scans in all 4 directions)
- '-' - Decrease the number of iterations (each iteration composed of scans in all 4 directions)
- '0'-'9' - Set the number of iterations to perform
- 'O' - Open .mat file containing the geometry of a parametric surface and source points
- 'S' - Save distance map to .mat file
- 'F' - Toggle between Bilinear and Nearest Neighbor filter mode display mode for magnification.
- 'P' - Toggle between smooth shading and points rendering
- 'T' - Toggle texture on/off
- 'Z' - Toggle random movement of sources