

HW5 Question1&2

Xu Yin 20205445

December 12, 2021

1 Question 1: Cotangent Laplacian

- Calculate the cotangent weight matrix (implemented by **iterating the half-edge structure**, see fun `Get_cotan()` in `Q1&2.cpp`).
- Get the Diagonal Vertex area matrix (**checking fun `Get_diag()` in `Q1&2.cpp`**).

2 Laplace-Beltrami Eigenfunctions

Using spectra to get the eigvalues and eigvectors (first 300 elements that greater than $1e^{-12}$, see Fig 1 and fun).

```
//Initialize and compute

using OpType = SymShiftInvert<double, Eigen::Sparse, Eigen::Sparse>;
using BOpType = SparseSymMatProd<double>;
OpType op(-Cotan_matrix, Diag_matrix);
BOPType Bop(Diag_matrix);
SymGEigsShiftSolver<OpType, BOPType, GEigsMode::ShiftInvert>
    eigs(op, Bop, 301, 650, -1e-5);

//SparseSymMatProd<double> op(-Cotan_matrix);
//SparseCholesky<double> Bop(Diag_matrix);
//SymGEigsSolver<SparseSymMatProd<double>, SparseCholesky<double>, GEigsMode::Cholesky>
//    eigs(op, Bop, 300, 601);

eigs.init();
int nconv = eigs.compute(SortRule::LargestMagn);

Eigen::VectorXcd evalues;
Eigen::MatrixXcd evectors;

if (eigs.info() == CompInfo::Successful)
{
    evalues = eigs.eigenvalues();
    evectors = eigs.eigenvectors();
}
```

Figure 1: Calculating the eigenvalues and vectors.

| | | | | |
|---------------------|-----------|-----------------------|-----------|------|
| source_3_eigvec.csv | 39,242 KB | 12/12/2021 下午 9:40:59 | rw-r--r-- | root |
| source_9_eigvec.csv | 39,237 KB | 12/12/2021 下午 9:43:46 | rw-r--r-- | root |
| source_7_eigvec.csv | 39,236 KB | 12/12/2021 下午 9:42:50 | rw-r--r-- | root |
| source_2_eigvec.csv | 39,215 KB | 12/12/2021 下午 9:40:31 | rw-r--r-- | root |
| source_1_eigvec.csv | 39,207 KB | 12/12/2021 下午 9:40:05 | rw-r--r-- | root |
| target_eigvec.csv | 39,178 KB | 12/12/2021 下午 9:39:37 | rw-r--r-- | root |
| source_8_eigvec.csv | 39,177 KB | 12/12/2021 下午 9:43:18 | rw-r--r-- | root |
| source_4_eigvec.csv | 39,158 KB | 12/12/2021 下午 9:41:27 | rw-r--r-- | root |
| source_6_eigvec.csv | 39,148 KB | 12/12/2021 下午 9:42:22 | rw-r--r-- | root |
| source_5_eigvec.csv | 39,143 KB | 12/12/2021 下午 9:41:54 | rw-r--r-- | root |
| source_6_eigval.csv | 4 KB | 12/12/2021 下午 9:42:21 | rw-r--r-- | root |
| source_5_eigval.csv | 4 KB | 12/12/2021 下午 9:41:53 | rw-r--r-- | root |
| target_eigval.csv | 4 KB | 12/12/2021 下午 9:39:36 | rw-r--r-- | root |
| source_4_eigval.csv | 4 KB | 12/12/2021 下午 9:41:26 | rw-r--r-- | root |
| source_1_eigval.csv | 4 KB | 12/12/2021 下午 9:40:04 | rw-r--r-- | root |
| source_8_eigval.csv | 4 KB | 12/12/2021 下午 9:43:17 | rw-r--r-- | root |
| source_2_eigval.csv | 4 KB | 12/12/2021 下午 9:40:30 | rw-r--r-- | root |
| source_9_eigval.csv | 4 KB | 12/12/2021 下午 9:43:45 | rw-r--r-- | root |
| source_3_eigval.csv | 4 KB | 12/12/2021 下午 9:40:58 | rw-r--r-- | root |
| source_7_eigval.csv | 4 KB | 12/12/2021 下午 9:42:49 | rw-r--r-- | root |

Figure 2: Example result.

```

/root/original/HW5/Results/target_eigval.csv
-2.600457
-3.464949
-4.998516
-7.523798
-10.700733
-21.280055
-22.301036
-29.575301
-32.386651
-46.696693
-54.009477
-63.262528
-69.405836
..

```

Figure 3: Example result.

3 Implementation

- you need to install the Eigen and Spectra library.
- You can run Report_all () to calculate the all meshes's eigen information, or run Eigen_computing to get the file of the specified mesh.
- After executing Report_all (), you would get all .csv files under the ". /Results/" folder (see Fig. 2 and Fig. 3).