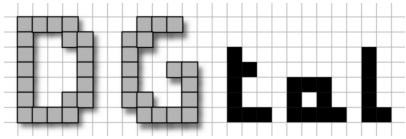

DGtal: Volumetric Geometry Package

http://liris.cnrs.fr/dgtal

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Package description

Should contain

- Methods performing geometric analysis of images, sets or objects as subset of $\mathbb{Z}^d$
- $\mathbb{Z}^d \rightarrow \mathbb{Z}^d$ functions

Examples

- Distance transformation, Reverse Distance, Digital Medial Axis extraction
- Geometrical moments computation
- Global volumetric shape descriptors
- ...
- Image transformation ? (Quasi-Affine Transform, digital rotations,...)

Location

- `{DGtal}\src\DGtal\geometry\nD\volumetric`
- `{DGtal}\tests\DGtal\geometry\nD`

In DGtal 0.4

Available:

- dD Separable Distance Transform (l_1, l_∞, l_2)
- dD Reverse DT (l_1, l_2)
- dD Simple measure (area, volume,...) shape descriptor

In progress (github branch):

- Digital Voronoi mapping

Scheduled:

- Medial axis extraction

Separable Distance Transformation

For each point of an object, we compute the minimum distance to the background

Overview of the algorithm

- Separable decomposition of the metric and the minimization process
- for each dimension, we have a double-scan of the volume

$\Rightarrow O(d \cdot n^d)$ for a n^d image.

Which metric?

- Any weighted l_p metric
- Chamfer mask in 2D
- ...

$\Rightarrow$ `SeparableMetricTraits`

Bottleneck

- For exact computations, the range of the output image value type is $O(d \cdot n^p)$.
- In the current implementation, we have a *double buffering* of the output image (could be replace to a single 1D buffer)

Implementation

DistanceTransformation

- Parametrized by an input image type, a static “p” value, and an optional internal value type
- Defines an `OutputImage` type
- Main method:

```
template <typename ForegroundPredicate>
OutputImage compute(const Image & inputImage, const ForegroundPredicate
& predicate );
```

ReverseDistanceTransformation

- Parametrized by an input image type, a static “p” value, and an optional internal value type
- Defines an `OutputImage` type
- The constructor needs two values for the background/foreground of the reconstruction
- Main methods:

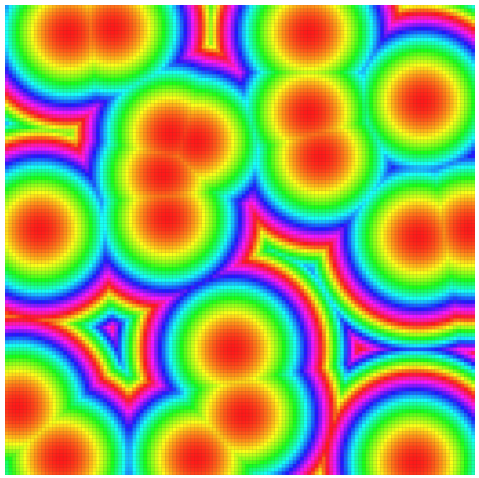
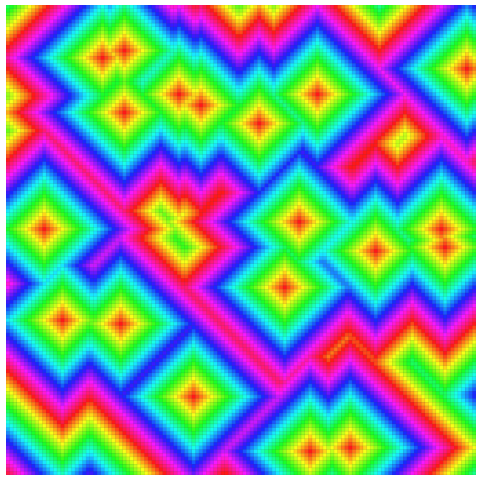
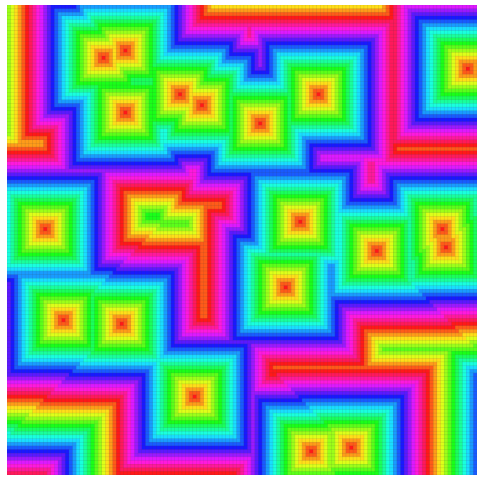
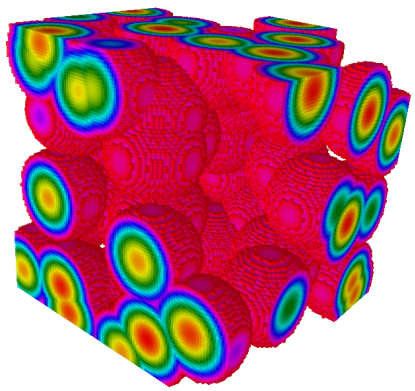
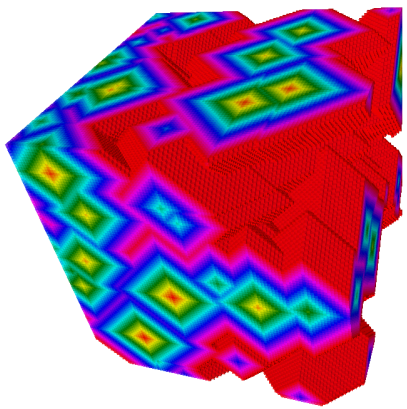
```
OutputImage reconstruction(const Image & inputImage);

template<typename DigitalSet>
void reconstructionAsSet(DigitalSet &aSet, const Image &inputImage);
```

Usage

```
1          //Domain BBox
2          Z2i::Point a ( 0, 0 );
3          Z2i::Point b ( 127, 127);
4
5          //Input image with unsigned char values
6          typedef ImageSelector<Z2i::Domain, unsigned int>::Type Image;
7          Image image ( a, b );
8
9          //We fill the image with the 128 value
10         for ( Image::Iterator it = image.begin(), itend = image.end();it != itend; ++it)
11         image.setValue(it)=128;
12         //We generate 16 seeds with 0 values.
13         randomSeeds(image,50,0);
14
15         //Types
16         typedef  DistanceTransformation<Image, 2> DTL2;
17         typedef  DistanceTransformation<Image, 0> DTLInf;
18
19         DTL2 dtL2;
20         DTLInf dtLinf;
21
22         //Main Computation
23         DTL2::OutputImage resultL2 = dtL2.compute ( image );
24         DTLInf::OutputImage resultLinf = dtLinf.compute ( image );
25
26         //Reconstruction types for the l2 metric
27         typedef ReverseDistanceTransformation< DTL2::OutputImage, 2 > ReverseDTL2
28         typedef ReverseDTL2::OutputImage ImageRDT;
29         ReverseDTL2 reverseDT;
30
31         //REDT Computation
32         ImageRDT reconstruction = reverseDT.reconstruction( resultL2 );
```

Examples


Future Works

TODO list

- Voronoi/Power diagram mapping (OutputImage = ImageContainer<Point>)
- RMA extraction
- Benchmark/Improve memory managment
- Out-of-core versions (meta tiled image container?)
- Add tools (thickness diagram, MA simplification, . . .)
- Volumetric based differential estimators
- QAT

Questions

- Mimic ITK/VTK image filters for volumetric transforms: e.g. output image as a DistanceTransformation class member and we return smart pointer ?