NORMAL MESH TECHNIQUES FOR CONTOUR APPROXIMATION

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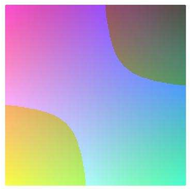
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Goal

Beating wavelet compression algorithms in the compression of geometrical images!

Horizon Images

- Information dominated by smooth contours
- Smoothly colored regions in between



Horizon Image

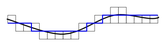


Horizon Image seen as a surface

Contour Approximation

Tensor product wavelets

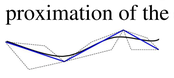
- Piecewise constant approximation of the contour:



- Gibbs effects around the contours

Normal offsets

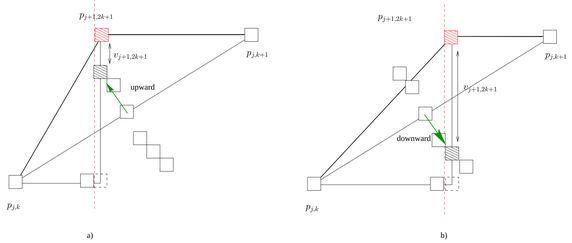
- Adaptive domain partitioning constructing a polyline approximation of the contour:



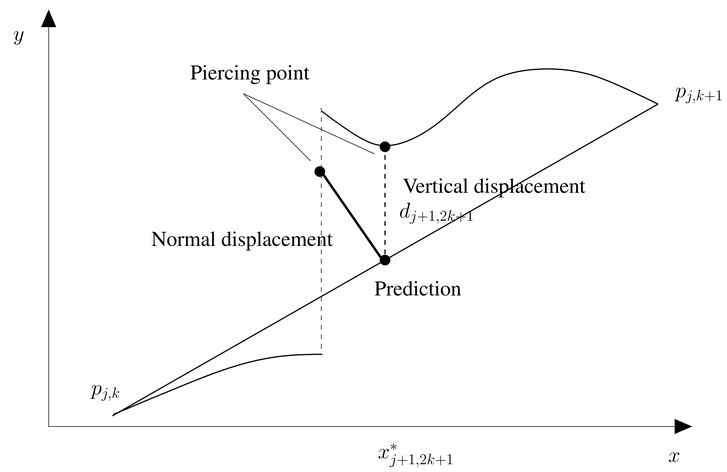
1D features

- **Piercing *points* are attracted** towards of steep function transitions
- Only ***1*** offset needed to express the relative **location *and* value** of a finer point

Discrete Setting



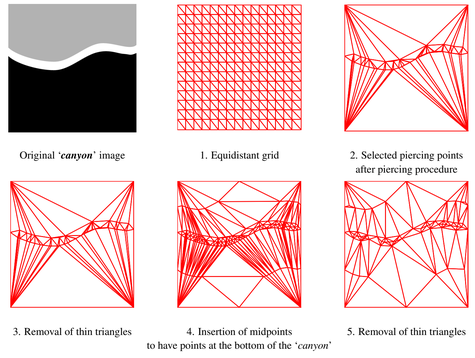
Concept of Normal Offsets



Extension to 2D

1. Through each line segment of the coarse mesh approximation define a plane $\perp$ on the xy-plane and apply the one dimensional scheme
   $\hookrightarrow$ edge refinement
2. Interconnect the newly found piercing points and triangle vertices **locally**
   $\hookrightarrow$ nested triangulation

Base Mesh Generation



Original '***canyon***' image

1. Equidistant grid

2. Selected piercing points after piercing procedure

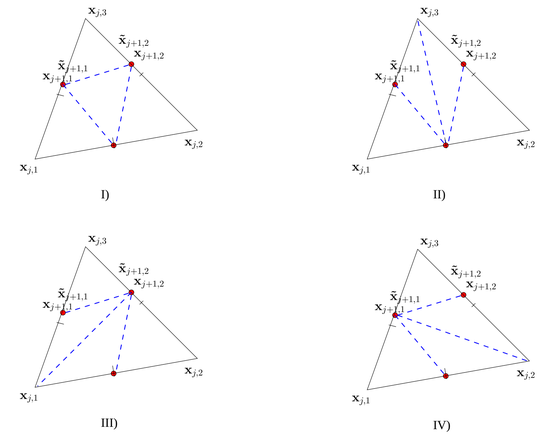
3. Removal of thin triangles

4. Insertion of midpoints to have points at the bottom of the '*canyon*'

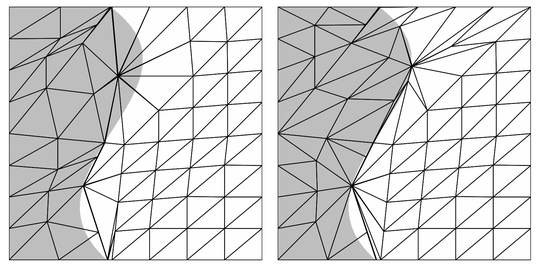
5. Removal of thin triangles

2D Features

- **Hierarchical pattern based triangulation**



- **Triangle *edges* are attracted** toward contours by adaptive triangulation



Subdivision connectivity

Pattern based connectivity

Geometric interpretation



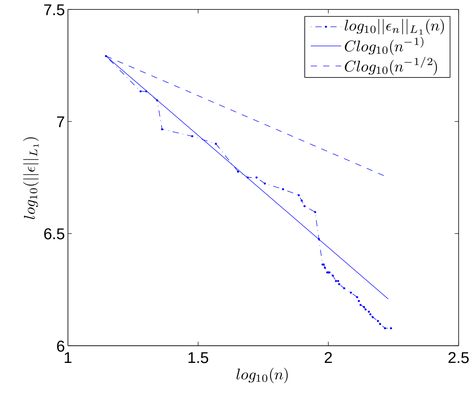
Low resolution $3D$ approximating mesh

High resolution $3D$ approximating mesh

Corresponding $2D$ Image after piercing procedure

Rate of Approximation

	DFT	DWT	Normal Offsets
transform	**Linear**	**Linear**	Nonlinear
n-terms selection	**Linear**	Nonlinear	Nonlinear
approximation rate α on $\mathcal{H}$	$1/4$	$1/2$	1



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Acknowledgments: This work is funded by the FWO (Flemish Fund for Scientific Research), being part of the SMID project G.0431.05 (Stability of Multiscale Transforms on Irregular Data).