Smart Ideas for Photomosaic Rendering
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Abstract
Photomosaic is a technique which transforms an input image into a rectangular grid of thumbnail images preserving the overall appearance. The typical photomosaic algorithm searches from a large database of images one picture that approximates a block of pixels in the main image. Since the quality of the output depends on the size of the database, it turns out that the bottleneck in each photomosaic algorithm is the searching process. In this paper we present a technique to speed-up this critical phase using the Antipole Tree Data Structure. Further we present some ideas to render an image in a “photomosaic style”. These techniques are based on QuadTree and fractal images and allow the creation of very interesting “photomosaic effects”.

The Antipole Tree Data Structure
We use the Antipole Tree Data Structure that is well suitable in every Metric Space $(X,d)$.

The Antipole Clustering
The Antipole Clustering of bounded radius $r$ is performed by a recursive top-down procedure starting from $X$ and checking if a radius with a distance greater than $r$ exists in every subsets.

- If such a radius doesn’t exist then splitting is not performed and the given subset is a cluster with a centroid having radius approximately less than $r$.
- Otherwise a pair of points $(A,B)$ of $X$ called Antipole is generated and it is used to split $X$ into two subsets $X_A$ and $X_B$.

Photomosaic Creation
First subdivide the input image into a regular grid, then each cell of the grid into another $3\times3$ sub-grid. Second compute the RGB mean values for each sub-cell of the sub-grid. This leads to a vector $x$ composed by $27$ components (three RGB components for each sub-cell). $x$ is the feature vector of the cell. After performing the best matching resize the selected tile to fit and paint it over the cell.

We implemented the concept of minimum distance between equal tiles to improve the final result: if we choose a tile, then it cannot be chosen again in its neighborhood (whenever this is possible).

QT-Photomosaic and FQT-Photomosaic
A Quadtree is a tree having four branches at each node. The basic principle of a Quadtree is to cover a planar region of interest by a square, then recursively partition squares into smaller squares until each square contains a suitably uniform subset of the input. In our problem the Quadtree is used to subdivide an image in squares such that each square has a RGB variance values lower than an user selected parameter. This leads to a new subdivision of the image, different than the classic rectangular regular grid.

Once we have obtained the Quadtree, it is possible to apply the same algorithm described for photomosaic in order to find the best matching tile in the Antipole Tree.

In FQT-Photomosaic, we extend the QuadTree idea in order to produce a fractal photomosaic image. To obtain this results we restrict, for each square, the database of thumbnail images to the image itself and its sequence of subQuadTree-images containing the square under observation. To perform this task we need to recursively compute the Antipole Tree for each square.

Experimental Results

<table>
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<th>Size</th>
<th>Total Mean Time (sec.)</th>
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</tbody>
</table>

Conclusions & Future Works
We presented a new method to speed-up the creation of photomosaic images. There are several ways to improve the aesthetic of our results and several ideas started from this work: extending photomosaic technique to other kind of mosaics, the use of Antipole Tree or other data structures in other fields of NPR to speed-up the rendering process. The extension of our method for photomosaic rendering of 3D surface is probably the most exciting direction of research.