**Introduction**

Estimating the actual head orientation from 2D images, with regard to its three degrees of freedom, is a well-known problem that is highly significant for a large number of applications involving head pose knowledge.

![Image 1: The rotations of the head in terms of Pitch, Yaw and Roll angles.](image1)

**Fractal Image Coding Approach**

In this paper we take a different approach to this topic by using fractal coding theory and particularly Partitioned Iterated Function Systems (PIFS). The basic principle is that an image can be reconstructed by using the self-similarities in the image itself. When encoding an image, the algorithm partitions the original image into non-overlapping domain regions; after this, a new partition into smaller blocks (range blocks) is applied.

![Image 2: The transformations between the domain blocks (D) and the range blocks (R), on image pairs featuring similar angular values.](image2)

For every range block, the best matching domain block is searched among all domain blocks by performing a set of isometric transformations on the blocks. The compression is obtained by storing only the descriptions of these transformations.

**Self-similarities and HPE**

Due to the self-similarity induced by the fractal codec, we obtain that the same blocks of Domain will go in the same blocks of Range for both images within an acceptable margin of error.

![Image 3: A detail of the fractal coding process, in particular the rotation and the lighting variation leading to the range located in row 8 and column 2.](image3)

**Proposed Method**

1. Face detection and extraction.
2. Fractal image coding algorithm to obtain a matrix representing the fractal codes.
3. Pose estimation, transforming the fractal parameters in an array and comparing it to the angular array references obtaining in the same way (fractal codes) through Hamming distance metric.

![Image 4: Workflow of the proposed method.](image4)

**Results**

We relied on BIWI and AFLW2000 datasets to perform the experiments. Our method based on fractal coding achieves results comparable with recent techniques though they are based on machine learning approaches.

We tested HPIFS using a well-known performance index for pose estimation, the Mean Absolute Error (MAE).

![Graph 1: Errors on BIWI in terms of angular poses.](graph1)

**Conclusions**

We presented HPIFS, a novel method for head pose estimation based on Partitioned Iterated Function Systems to extract a fractal image code from input face to be matched against a reference array through Hamming distance. According to the results of experiments carried out on both BIWI and AFLW2000 reference datasets, the reported pose estimation error is comparable to that of state-of-the-art methods based on machine learning and often inferior to that reported by the best performing non-training based methods.

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