CRANIOFACIAL LANDMARK LOCALIZATION WITH ASYMMETRY PATTERNS SHAPE CONTEXTS

Federico M. Sukno[1,2], John L. Waddington[2] and Paul F. Whelan[1]
[1]*Centre for Image Processing & Analysis, Dublin City University, Dublin 9, Ireland*
[2]*Molecular & Cellular Therapeutics, Royal College of Surgeons in Ireland, Dublin 2, Ireland*
federico.sukno@dcu.ie

Abstract:

We present a new family of 3D geometry descriptors based on the asymmetry patterns present in the popular 3D Shape Contexts (3DSC)[1]. Our approach resolves the azimuth ambiguity of 3DSC, thus providing rotational invariance, at the expense of a marginal increase in computational load, outperforming previous algorithms dealing with the azimuth ambiguity.

We build on a recently presented measure of approximate rotational symmetry in 2D [2] defined as the overlapping area between a shape and rotated versions of itself, to extract asymmetry patterns from a 3DSC in a variety of ways, depending on the spatial relationships that need to be highlighted or disabled. Thus, we define Asymmetry Patterns Shape Contexts (APSC) [3] from a subset of the possible spatial relations present in the spherical grid of 3DSC; hence they can be thought of as a family of descriptors that depend on the subset that is selected. This provides great flexibility to derive different descriptors.

We quantify the performance of the proposed descriptors for craniofacial landmark localization, targeting 22 points relevant in the context of dysmorphology research [4]. Measuring the performance in terms of distance to expert annotations we show that APSC can achieve overall accuracy comparable to 3DSC; the rotational invariance of APSC is achieved at the expense of a small computation overhead to build the descriptor (typically < 10%) but implies a speedup during matching by a factor of twice the number of azimuth bins (typically 24 : 1).

Moreover, the possibility to define APSC descriptors by selecting diverse spatial patterns from a 3DSC has two important advantages: 1) choosing the appropriate spatial patterns can considerably reduce the errors obtained with 3DSC when targeting specific types of points; 2) Once one APSC descriptor is built, additional ones can be built with only incremental cost. Therefore, it is possible to use a pool of APSC descriptors to maximize accuracy without a large increase in computational cost.

References:

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