

Landmarks to curves to surfaces: hierarchical representation of a human face

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A three-dimensional image of the human face can be captured by, for example stereophotogrammetry. Subsequent smoothing is often needed because of imperfections of surface representation. Compared with anatomical landmarks, curves have the advantage of providing a much richer description of facial shape. In the talk, this is explored in the context of identifying the jaw line, the boundary between the lower and upper lip and surrounding skin, the philtrum valley, the nasal profile, the boundary between the nose and surrounding skin, the nasal ridge, the boundary between the lower eyelid and the surrounding skin, the brow ridges, and some geodesics on the nose and cheeks (the areas without valleys or ridges) between two carefully chosen anatomical landmarks. These curves, defined by semi-landmarks, are automatically identified by curvature in particular local surface patches, detection of slope discontinuities in local principal curves or optimised surface cuts. A full standardised surface representation is then available by interpolation across the relatively flat surface patches between identified curves. Each level of this hierarchical structure (landmarks, curves, surfaces) is amenable to shape analysis. For the purposes of visualisation, a high resolution template can be fitted to the semi-landmark surface by warping. Where the semi-landmarks and/or template have a symmetric structure this leads to natural ways of quantifying asymmetry. These methods will be illustrated on facial images collected under different studies.

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