Expression-Invariant Face Recognition with Expression Classification

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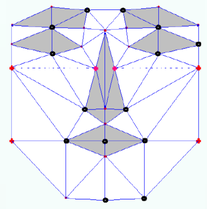
Expression-invariant face recognition

1. Facial expression affects the performance of a face recognition
2. Expression changes face geometry, but texture is stable.
3. We conduct recognition based on texture /geometry separately.

Related works

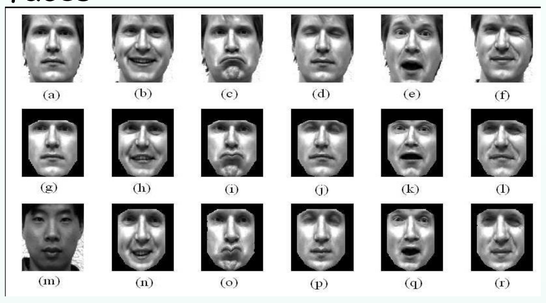
Separately modeling texture and geometry information in different eigenspaces has been applied in ASM and AAM (by Cootes et al.), however our eigenspaces aim at distinguishing individuals and expressions.

Mask fitting and warping



34 vertexes and
51 triangles

Normal faces — Expressioned faces



Natural warpings VS Artificial warpings

Natural warping: warping from test face to the reference face of the same individual.

Artificial warping: warping from test face to the reference face of a different individual.

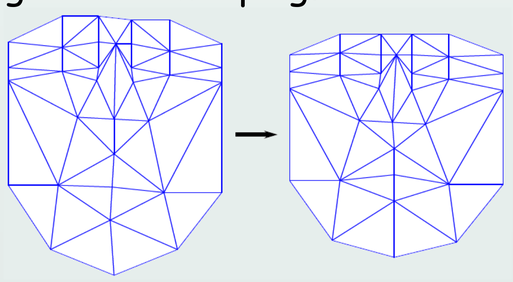
Feature spaces and recognition methods

Space1: Texture space V_{tex}: eigenspace of warped face textures.

Space2: Angle space V_{ang} : eigenspace of the weighted inner angles of masks. Angle weight is the inverse of the angle variance in natural warpings of training faces.

Face recognition: the projection of testing face into V_{tex} and V_{ang} are used as two attributes in face recognition by distinguishing natural warpings from artificial warpings. A testing face is recognized as the same individual in a reference face if both attributes are similar.

Space3: Angle residual space V_{res} : eigenspace of the angle changes during natural warping.



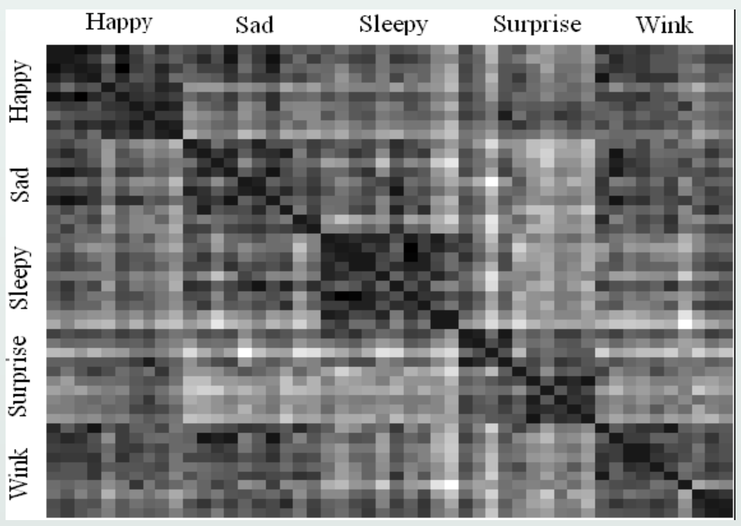
Warping from "surprise" to "normal"

Expression classification: compare the geometry of a testing face with that of the recognized reference face in V_{res}.

Results of face recognition

		experi-ment 1	experi-ment 2	experi-ment 3	over all
(1)	original face	22/25	17/25	23/25	82%
(2)	texture attribute	24/25	23/25	23/25	93.3%
(3)	geometry attribute	12/25	12/25	15/25	52%
(4)	weighted geometry attribute	14/25	17/25	18/25	65.3%
(5)	Combined recognition	25/25	23/25	24/25	96%

Results of expression classification: 84%



Extension: face recognition on noisy 3D face scan:

1. Expression affects 3D face recognition more seriously, since most geometric features will be mis-aligned.
2. 3D face mask carries face shape information. The displacement from a mask to its original face carries face surface feature.
3. In a natural warping, an expressioned face will approach its reference face, by removing expression. In an artificial warping, however, face surface features of testing face will be distorted.