Age Estimation Based on Gaussian Process Regression of AAM Parameters Using Hollywood Database

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1. Introduction

Age estimation is an interesting and challenging problem in the area of computer vision. Aging causes significant variations in the appearance of face. So recently many researches about emotion, gender and aging identification by using facial images are widely developed.

2. Related Works

Active Appearance Model(AAM)[1]has been popularly used to represent the appearance and shape variations of human faces. Based on the feature points obtained by AAM, we can obtain the age feature regions.

Gaussian Processes Regression(GPR)[2] is a method for Non-linear regression. It can be seen as a generalization of Gaussian Distributions. Unlike the other classifications which consider aging as a class label and get an age-span, the GPR is non-linear method and gets an accurate estimation of the age.

3. Age Estimation Methods

Gaussian Processes for Regression is used in age estimation algorithms as shown in Fig.1 after extraction of AAM fitting parameters.



Fig.1 Flowchart of age estimation

We define the kernel matrix $k(x,\bar{x})$ as Eq. (1),

$$k(x,\overline{x}) = \sigma_f^2 exp \frac{-\|x-\overline{x}\|^2}{l^2} + \sigma_n^2 \delta(x,\overline{x})$$
(1)

 σ_f : vertical lengthscale l : horizontal lengthscale σ_n : noise

where σ_f and σ_n can be learnt from data automatically. Given a data points x, we determine corresponding age output y. According to the Eq. (2), we obtain yest for the age prediction.

$$\mathbf{y}_{est} = \mathbf{K}_* \mathbf{K}^{-1} \mathbf{y} \tag{2}$$

4. Experiment

Age estimation based on AAM begins with building the shape model and texture model. we used 48 landmark points to mark the characteristics on the face, such as the eyebrows, eyes, nose and mouth.

The collection of sufficient training data for age estimation is extremely laborious. In the literature, the standard aging database such as FG-NET and MORPHY which cover a wide range of age are used but it is not a good choice for data-training. So we build a database including 350 images from 29 stars, because most of them have a career starting from teenage years to senior years.

5. Experimental Results

The performance of the age estimation was evaluated by MAE (Mean Absolute Error) defined as Eq.(3)

$$MAE = \sum_{k=1}^{M} |\overline{age_k} - age_k| / M$$
(3)

where \overline{age}_k is the estimated age of person k and age_k is his/her true age.

We used MORPHY database which contains 515 subjects with the age of 15 to 68 to compare the results. The results shown in Table.1 indicate that GPR achieves the best MAE.

Table.1 Prediction errors (in MAE) of different age	•
estimation algorithms on the MORPHY database	

Mean Absolute Error of Age Estimation			
Method	Description	MAE(years)	
k-NN	k-Nearest Neighbors	11.30	
BP	Back Propagation neural network	13.84	
SVM	Support Vector Machine	9.23	
GPR	Gaussian Processes for Regression	5.35	

6. Conclusions

We have got the appearance parameter by Active Appearance Model then used Gaussian Processes for Regression to build the age estimation. Experimental results showed that GPR can achieve better performance than other compared algorithms.

References

- [1] T.F.Cootes, Active Appearance Models, European Conference on Computer Vision (1998)
- [2] C.E.Rasmussen and C.K.I. Williams, Gaussian Processes for Machine Learning, MIT Press(2006)