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THERMAL FACIAL PATTERN RECOGNITION FOR PERSONAL VERIFICATION USING FUZZY CMAC MODEL

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Abstract. *This paper presents a novel personal verification system with thermal facial patterns using fuzzy neural network techniques. In contrast to traditional biometrics, the use of thermal technology removes two concerns in existing verification systems; they are: 1) the hygiene issue for verification systems that require physical contact (e.g., fingerprints) and, 2) variation in ambient illumination for visible-band camera verification system. In the proposed verification process, features extracted from thermal facial images are matched with trained fuzzy neural networks, in particular, the biologically inspired TSK^0-FCMAC, a fuzzy cerebellar model articulation controller (CMAC) based on the zero-ordered Takagi-Sugeno-Kang (TSK) fuzzy inference scheme. TSK^0-FCMAC is capable of performing localized online training with an effective fuzzy inference scheme. Preliminary simulations show that the proposed verification system is able to achieve an Equal Error Rate (EER) of 6.1% and the True Acceptance Rate (TAR) of above 86% for identification. The work in this paper shows that the thermal face patterns can provide a reasonable level of discriminating power, and has the potential to be used in the context of biometric applications especially when used in conjunction with other biometric modalities.*

Keywords: Zero-ordered Takagi Sugeno Kang fuzzy neural network, Localized fuzzy association memory, TSK^0-FCMAC, Discrete incremental clustering (DIC), Thermal facial pattern, Personal verification

1. **Introduction.** Biometrics refers to the automatic recognition of a person based on his/her physiological and/or behavioral traits. Biometric research has drawn considerable attentions to industry in the past decade because of the great demand of accurate and reliable security systems. Comparing with other biometric traits such as iris, fingerprint and retina, face recognition has highest user acceptance. The process of face recognition is totally nonintrusive. Although many researchers have put significant efforts on face recognition, the performance of the systems is still subject to light conditions, facial expression and aging of users. The most fundamental problem of face recognition is that facial features have limited distinctive information for personal identification and these features are genetically dependent, which means that genetically identical twins have very similar facial features. Some researchers countered this problem by adopting near infrared imagery as a way to reduce the effect of variable lighting, often by fusing both visible and infrared modalities to improve recognition performance [1-3]. Another new and novel approach utilizing thermal imaging of face has recently been suggested [4], which will not only tackle the illumination problem, but also introduce a new set of features for face recognition.