**Motivation**
- Biometrics are being used for authentication in access control system.
- Biometric traits cannot be replaced or regenerated in case of identity theft or data-base compromise.
- Biometric systems obtain feature vector representing person’s identity and these feature vectors (templates) cannot be secured using cryptographic hash due to intra-class variability in multiple acquisitions of biometrics.
- To counter this intra-user variability, we use forward error correcting (FEC) codes.
- As long as enrollment and probe feature vectors are within error correcting distance of the FEC code, authentication will succeed.
- Multibiometric systems offer improved accuracy, flexibility, coverage and better protection against spoofing compared to unimodal systems [1].

**System Model**

- **Cancelable Template Block (CTB)**
  - Uses deep neural network (DNN) for feature extraction.
  - DNN output is binarized and user-specific reliable bits are generated to form the cancelable template.
- **Secure Sketch Template Block (SSTB)**
  - The output of CTB is considered to be the noisy codeword of N symbols.
  - This noisy codeword is decoded with a forward error correction (FEC) decoder.
  - The output of the FEC decoder is the multibiometric secure sketch.

**Deep Neural Network-Fully Connected Architecture (FCA)**
- The outputs of the Face-CNN and Iris-CNN are concatenated vertically and passed through a fully connected layer.
- Size of face feature vector = 4096; Size of iris feature vector = 4096; Size of joint feature vector = 4096

**Deep Neural Network-Bilinear Architecture (BLA)**
- The outputs of the Face-CNN and Iris-CNN are concatenated using the matrix outer product of the face and iris feature vectors.
- Size of face feature vector = 64; Size of iris feature vector = 64; Size of joint feature vector = 4096

**Experiments and Numerical Results**
- VGG-19 [2] used as a starting point for the Face and Iris CNNs in DNN.
- The DNN is fine-tuned on WVU multimodal database [3], [2].
- Testing conducted on 50 disjoint subjects (not seen in training) from the WVU multimodal database.
- Reed-Solomon code used for FEC decoding and generating the secure sketch.

**Benefits and Conclusions**
- Feature extraction capability of convolutional neural networks utilized to generate a robust multibiometric shared representation.
- The system gives high matching performance in addition to high security.
- Error correcting capabilities of a Reed-Solomon code utilized to counter the intra-user variability of biometrics measurements.

**References**