ECG Recognition & Classification

Bell Canada Chair in Multimedia

IPSI: Identity, Privacy and Security initiative @ UofT

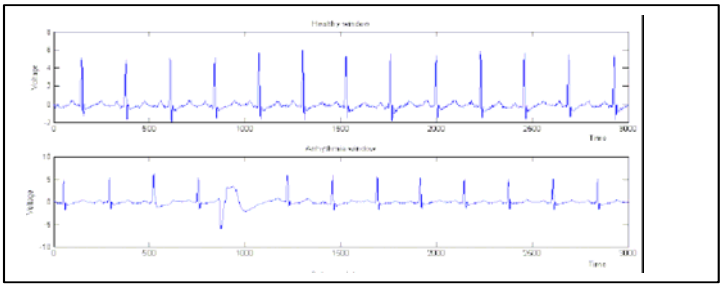
Security concerns increase as the technology for falsification advances. There are strong evidences that a difficult to falsify biometric trait, the human heartbeat, can be used for identity recognition.

Existing solutions for biometric recognition from electrocardiogram (ECG) signals are based on temporal and amplitude distances between detected fiducial points. Such methods rely heavily on the accuracy of fiducial detection, which is still an open problem due to the difficulty in exact localization of wave boundaries.

Our systematic analysis for human identification from ECG data removes the emphasis from fiducial detection and achieves high recognition performance with low complexity and simplicity.

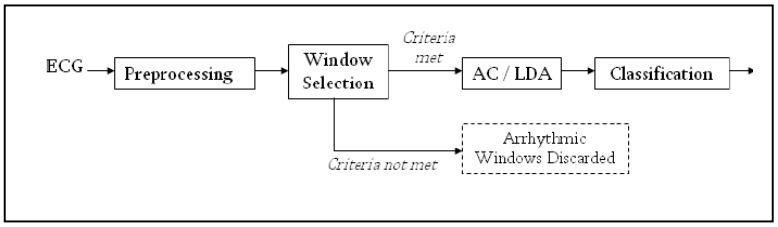
The subject recognition rate is 98% and the ECG window recognition rate is 95.6%. Furthermore, misclassified cases appear only among the arrhythmia subjects while healthy subjects have a 100% window recognition rate.

Our appearance based method captures the holistic patterns in a heartbeat signal, and only the detection of the *R* peak is necessary. This is generally easier since *R* corresponds to the highest and sharpest peak in a heartbeat. To better utilize the complementary characteristics of different types of features and improve the recognition accuracy, we propose a hierarchical scheme for the integration of analytic and appearance attributes.



Healthy and arrhythmic ECG windows from the same subject

Our autocorrelation-based method is a very simple and effective approach that does not require any waveform detection. It depends on estimating and classifying the significant coefficients of the Discrete Cosine Transform (DCT) of the windowed autocorrelation of heartbeat signals. Recently, we have extended this method to cases of arrhythmias by introducing a novel procedure for classification of healthy vs. arrhythmic ECG windows prior to ECG recognition.



We also explore cryptographic key generation and distribution methodologies in body area networks by exploiting time varying characteristics of multiple ECG signals. Our fuzzy key generation and distribution scheme provides a more flexible and computationally efficient alternative to existing solutions.

Recent Publications:

1. F. Agrafioti and D. Hatzinakos, ""ECG based human identification in Arrhythmia scenarios", submitted to Eurasip Pattern Recognition, June 2007
2. F. M. Bui and D. Hatzinakos, " Resource allocation strategies for secure and efficient communications in biometrics-based body sensor networks", Biometrics Symposium, BSYM-2007.
3. F. Bui and D. Hatzinakos, " Biometric methods for secure communications in body sensor networks: Resource-efficient key management and signal-level data scrambling", submitted to Eurasip Journal on Applied Signal Processing, May 2007.
4. F. Agrafioti and D. Hatzinakos, " A low complexity human identification method based on electrocardiogram (ECG) signals, to appear, Biometrics Symposium 2007.
5. Wang, F. Agrafioti, D. Hatzinakos, and K. Plataniotis, " Analysis of Human Electrocardiogram (ECG) for Biometric Recognition", submitted to Eurasip Journal on Applied Signal Processing, May 2006.
6. K. Plataniotis, D. Hatzinakos and J. Lee, "ECG Biometric Recognition without Fiducial Detection", Biometrics Symposium/Biometrics Consortium Conference, BCC'06}, Baltimore, Sept. 19-21, 2006.
7. Yongjin Wang, K. Plataniotis, and D. Hatzinakos, "Integrating analytic and appearance attributes for human identification from ECG signals", Biometrics Symposium/Biometrics Consortium Conference, BCC'06}, Baltimore, Sept. 19-21, 2006.

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