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

As a clinical tool, ECG has enormous applications in heart condition diagnoses. As a biometric tool, it is particularly powerful in discriminating subjects, because of the various electrophysiological properties of the heart. Advantages and disadvantages include:

| ✔ Universality          | ✗ Privacy concerns          |
| ✔ Uniqueness            | ✔ Cardiac disorders         |
| ✔ Liveness detection    | ✗ Time dependency           |
| ✔ Robustness to attacks |                       |
| ✔ Continuous authentication |                                |
| ✔ Data minimization     |                       |

**Recognition Algorithms**

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. 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 (AC/DCT) of the Linear Discriminant Analysis (AC/LDA) of the windowed autocorrelation of heartbeat signals.

Contact: D. Hatzinakos, (dimitris@comm.utoronto.ca), K. Plataniotis, (kostas@comm.utoronto.ca)
Cardiac Disorders

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 designed an identification system robust to common cardiac irregularities such as premature ventricular (PVC) and atrial (APC) contractions. Criteria concerning the power distribution and complexity of the signals are used to bring to light abnormal ECG recordings, which are not employable for matching.

Experimental results indicate a recognition rate of 96.2%, with misclassification taking place mostly among irregular recordings.

Privacy Concerns

We have explored privacy-oriented monitoring topologies which use ECG biometric recognition. A two step framework was developed, to allocate medical data to the particular patient folders, with anonymity guarantees.

An ECG identification block acts as precursor, delivering a ranked list of potential candidates. Then a validation scheme is applied to this pruned list of candidates.

This secondary step is shown to offer more flexibility in achieving improved misclassification rates.

Time Dependency

Another aspect of our research in ECG biometrics, is the investigation of destabilizing factors such as the physical or psychological activity. Physical activities may increase the heart rate, which is usually treated with HRV corrections of the features. The psychological activity on the other hand, results in very a unpredictable behavior. Since it is impossible to train the recognizers on all emotional expressions, our group has developed a methodology which can capture the instantaneous behavior of the signal in a template.

Contact: D. Hatzinakos, (dimitris@comm.utoronto.ca), K. Plataniotis, (kostas@comm.utoronto.ca)
Recent Publications:


Contact: D. Hatzinakos, (dimitris@comm.utoronto.ca), K. Plataniotis, (kostas@comm.utoronto.ca)