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Book Review: Biometrics

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TR-2000-07 March 2000

Abstract

Review of **Biometrics: Personal Identification in a Networked Society.** Kluwer Academic Publishers. Edited by Anil Jain, Ruud Bolle, and Sharath Pankanti, 1999.

Published in Pattern Analysis and Applications, March, 2000.

1. First printing, TR2000-07, March, 2000.

In the sense used by this book, biometrics is the measurement of personal identity using the distinguishing traits of people. These traits can be sensed physical characteristics (the face, iris, retina, hand, ear), signatures of an individual's motor control mechanisms (gait, signature, typing keystroke dynamics) or biochemical properties (odor, DNA).

In an excellent introductory chapter, the editors spell out why biometric measurements are topical and important. Estimated annual losses due to fraud include $3 billion for ATM's (25% of ATM users write their PINs on the ATM card!), $500 million for a single credit card company, and $1 billion for fraudulent cellular phone calls. Biometric methods of personal identification could dramatically reduce thefts of property or information. In our networked and automated society, we need to know who is who.

The editors also lay out issues in evaluating and selecting biometric methods. Is the biometric to be used for *verifying* a claimed identity (Am I who I claim I am?), or for *identifying* an unknown person (Who am I?). The editors list desirable properties on which to compare the different biometrics: universality, uniqueness, permanence, collectability, acceptability, difficulty of circumvention, and achievable practical performance.

Perhaps evidence of the economic interests at stake, the editors treat the different biometric methods with almost excessive even-handedness. In the overview, or in a subsequent chapter, a critical comparison between the different methods would have been useful. The most direct comparision is a table in the overview comparing the different biometrics on scales of desirable properties, although no reasons for the different evaluations are given. The editors do not even claim or assign credit for those judgements; the caption says the ratings are "based on the perception of three biometric experts"–the three editors?.

Following the overview chapter is a collection of contributed chapters. The first eight describe the primary biometrics which have been deployed, written by a researcher in each field: face, fingerprint, hand geometry, iris, retinal pattern, signature, voice-print, and thermograms. Following those are five chapters on other biometrics which the editors describe as still in the research stage for on-line identification: keystroke dynamics, gait, odor, ear, and DNA. The final chapters describe large-scale systems, multi-modal biometrics, biometric evaluation, smart cards, and privacy and policy concerns.

This is the first book to appear on biometrics. (There was a special issue of the Proceedings of the IEEE on Automated Biometrics (Sept. 1997, Vol. 85, no. 9)). It is an important and useful compilation which fills a need for

a comprehensive overview of biometric technologies. It is a timely survey of an area that will become more and more important in the future. Collected in one place are a set of proposals for the different biometric technologies.

Some of the individual chapters are weakened by bias on the part of the individual authors. (A short biography of each author would have been helpful in pointing out biases). The chapter on face recognition, an area with many different methods to cover, focuses mostly on the authors' particular approach, and introduces non-standard nomenclature to describe standard terminology (for example, using "Most Expressive Features" instead of the standard "eigenfaces"). A few of the chapters describing commercial systems give a presentation reminiscent of company advertising material ("While this placement feels unnatural at first, left hand verification becomes easier with practise", and "Their applications are limited only by imagination"). The chapter about on-line signature verification also described a particular algorithm of the author instead of providing a survey of different approaches.

The chapter on infrared imaging didn't make the technical case needed to support the authors' optimism for the technique. For example, as evidence that thermograms are unique to each individual, they showed pseudo-colored thermograms of different people. But pseudo-coloring accentuates both the reliable and the artifactual differences; they didn't show the obvious controls of thermograms of the same person at different times.

But many of the chapters are gems. John Daugman's contribution is mathematically rigorous and makes a compelling case for the strength of iris recognition as a biometric. He proposes using statistical decision theory to compare the decision making power of different biometrics.

Another outstanding chapter is that of John Woodward, who reviewed law and policy issues. Woodward situates the technology in society and law. This non-technical chapter provides some of the cross-method comparisons that are lacking in the rest of the book. The chapter raises important issues: big-brother; a possible secondary market for biometric information; and the potential for medical and health history captured through biometric identification. Woodward thoughtfully addresses the concerns, concluding (not surprisingly) that biometrics is privacy's friend, because it can help protect information integrity. One misses what would have been an inspired addition to the book: the inclusion of a chapter or a section by an articulate opponent of biometric technology.

Several other chapters are notably broad in their outlook. O'Gorman's chapter on fingerprint verification surveyed many approaches and their trade-offs. He included an overview of practical systems issues, as well as questions

to ask when evaluating performance reports.

Nixon et al gave a balanced and realistic review of the admitedly exploratory state of gait recognition. Germain's chapter on large scale systems appeared to be particularly even-handed and fair.

There are only a few spots where the reader notices careless editing. Table 8.2 is a selected chronology of speaker-recognition progress, presented without any dates. Of more concern, the chapter on multi-modal biometrics has glaring grammatical mistakes throughout.

Perhaps evidence of the difficulties of scholarship in our modern era: of 24 reference citations to web pages in the overview chapter, only 7 were still available by the end of the copyright year of the book. The modern fix to that would be to make available a web page with the corrections and updates.

In general, Biometrics is a very useful and readable collection. It will be accessible to a general technical audience, although some exposure to statistics and pattern recognition is helpful. The collection provides a useful reference in this emerging field.