



2010 - 08B-CC1 - Optimal Finger Combinations in Multi-Finger Biometric Systems - michels@purdue.edu - IAP

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Optimal Finger Combinations in Multi-Finger Biometric Systems Michels, M., Elliott, S.J., Ph.D., & Modi, S.K. Ph.D. Biometrics Standards, Performances, and Assurance Laboratory Department of Industrial Technology, College of Technology, Purdue University

Motivation

US Governmental fingerprinting systems at airports (US-VISIT) & borders have switched to using ten-print fingerprint systems, which takes longer to verify a user than its single/dual-print counterparts, while also having a better chance at verifying a user and less matching errors.

Purpose

• To find the optimal number of fingers to use in a biometric system that provides the best trade-off between verification speed and fewest matching errors.

Results & Analysis

Table 4.1-Right Hand Quality Table 4.3 – Right Hand Error Rates Scores Ring Standard Middle Little Median Thumb Index Mean Deviation FRR 0.0% 0.5556% 0.0% 0.0% 0.0% 1.02 Thumb 1.43 FAR 0.0% 0.01% 0.0% 0.0% 0.0% Index 1.87 .97 Table 4.4 – Left Hand Error Rates Middle 1.82 1.94 Thumb Index Middle Ring Little Ring 1.13 1.74 0.00% 0.0% 0.00% 0.00% 0.00% FRR 1.17 2.3 Little 0.0048% 0.0524% 0.00% 0.00% 0.00% 0.00% 0.00% FAR 0.00%
 Table 4.2-Left Hand Quality Scores
 Combination FRR (at FAR=0.0%) Combinations Median Standard Mean Level Deviation 0.005556 RR 1.43 1.02 Thumb 0.016575 LP,RR 1.75 Index .93 LP,RR,RP 0.016216 Middle 1.09 0.015707 LP,RM,RR,RP LP,RI,RM,RR,RP 0.015464 1.74 1.13 Ring LR,LP,RI,RR,RP, 0.004926 2.3 1.17 Little RTH LM,LR,LP,RI,RR,RP, 0.004926 RTH

Methodology

Data collected from 70 individuals, 65 righthanded, 5 left-handed.



 Table 4.6 - Optimal Finger Combinations

0.004926

LI,LM,LR,LP,RI,RR,

RP,RTH

Combination	FRR (at FAR = 0.0%)	Optimal Combinations
Level		
1	0	[LTH], [RTH], [RI], [LI]
2	0	[LI,LTH], [LI,RTH], [RI,LTH], [RI,RTH]
3	0	[LI,RI,RTH,LTH], [LI,LM,RTH,LTH],[LM,RI,RTH,LTH]
4	0	[LI,RI,RTH,LTH], [LI,LM,RTH,LTH],[LM,RI,RTH,LTH]
5	0	[LI,LM,RI,RTH,LTH], [LI,LM,RM,RTH,LTH]
6	0	[LI,LM,RI,RM,RTH,LTH], [LI,LM,RI,LR,RTH,LTH]
7	0	[LI,LM,LR,RI,RM,RTH,LTH], [LI,LM,RI,RM,RR,RTH,LTH],
8	0	[LI,LM,LR,RI,RM,RR,RTH,LTH], [LI,LM,RI,RM,RR,RP,RTH,LTH],
9	0	[LI,LM,LR,RI,RM,RR,RP,RTH,LTH], [LI,LM,LR,LP,RI,RM,RR,RTH,LTH],
10	0	All Fingers

• Genuine match scores decrease as number of fingers increase.

Conclusions

- Optimal number of fingerprints to use is inclusively between four and six fingers.

Combinations should include the Thumbs,

Indexes, and Middle Fingers of each hand.

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