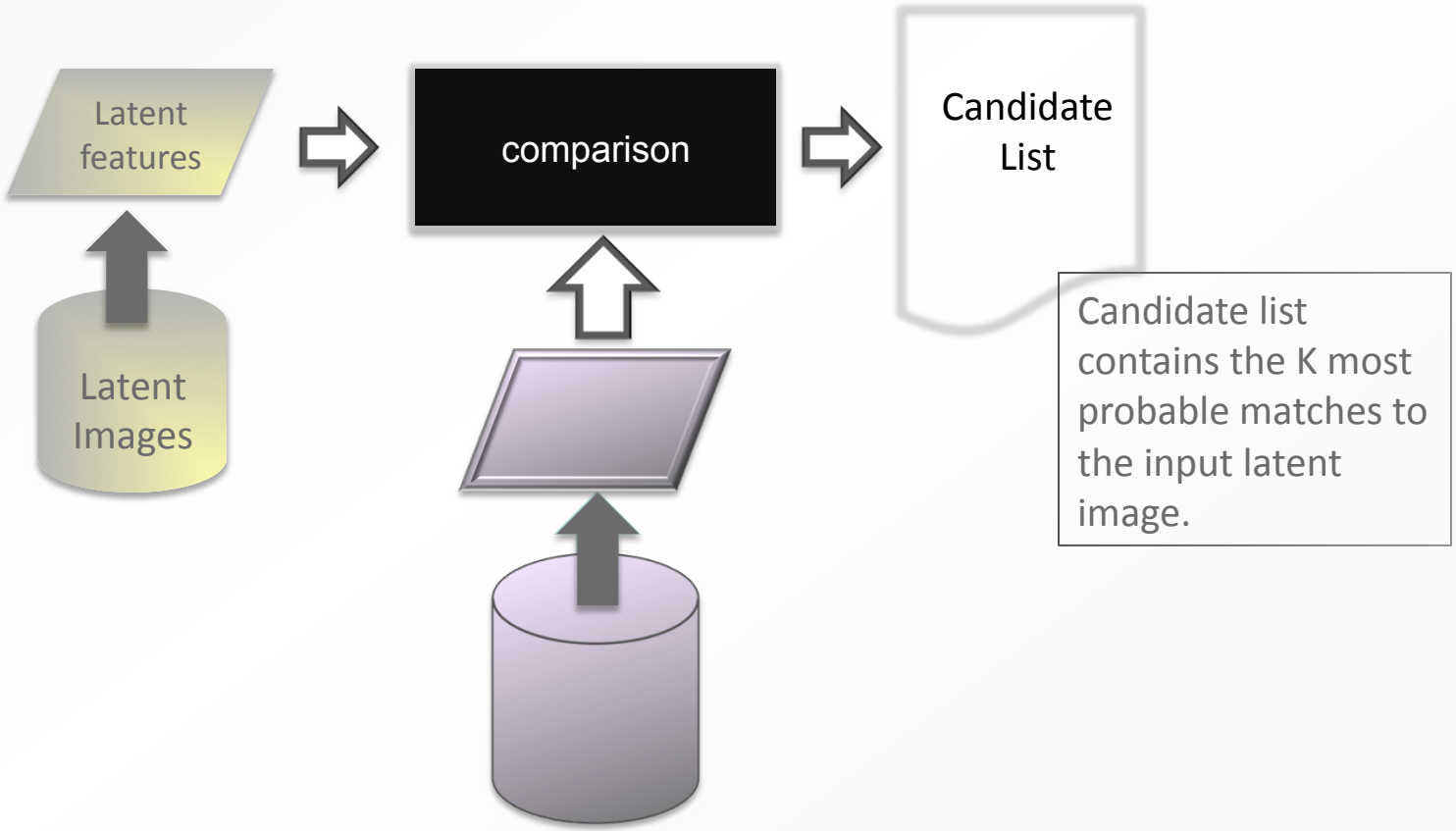
ELFT :: Analysis of factors affecting performance

Elham Tabassi

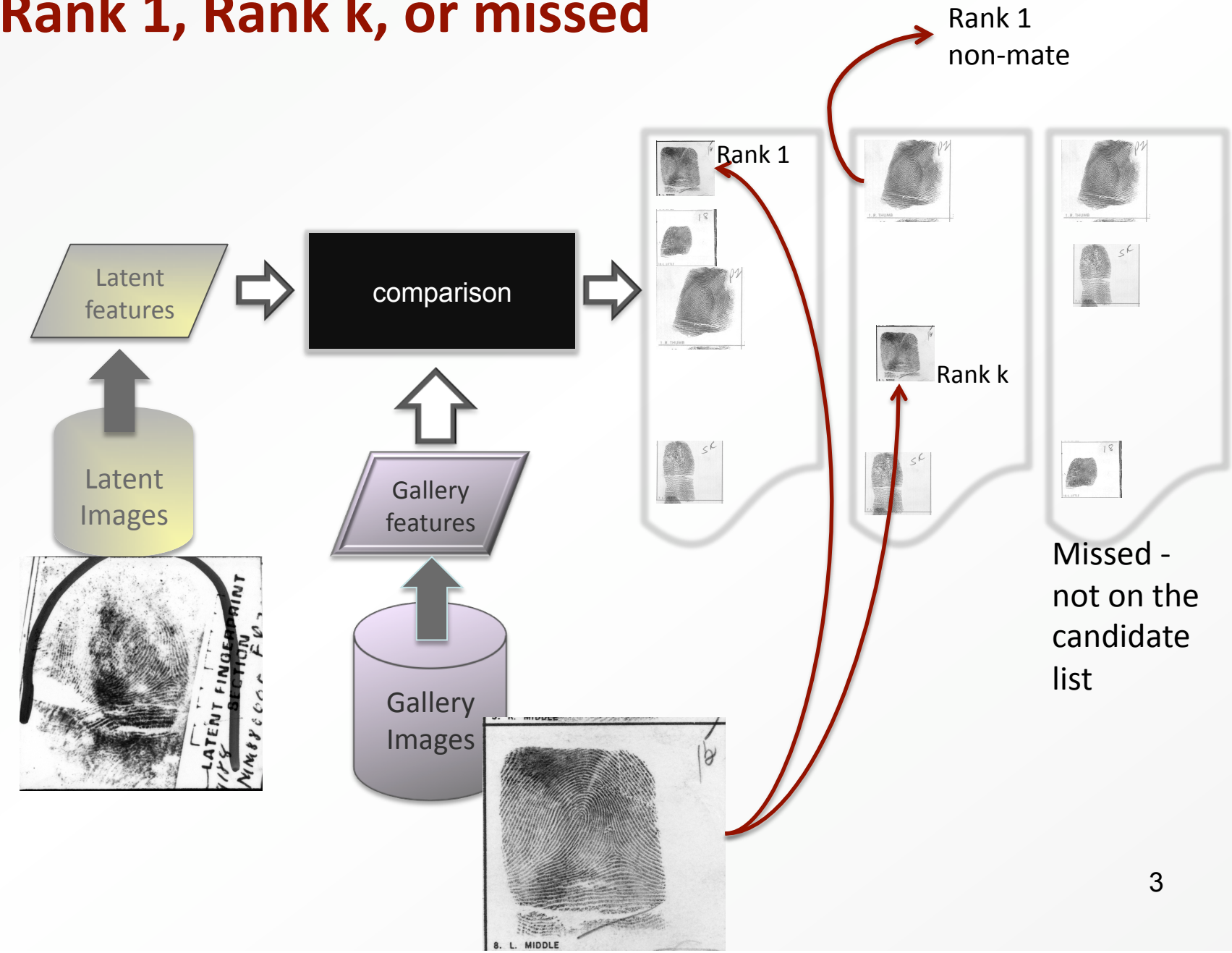
NIST Latent Workshop

19 March 2009

Overview of Identification



Rank 1, Rank k, or missed



Which are Hard to Match Latents?

Those that no SDK identified them at Rank 1.

The last 1.8%

1000ppi – Gallery 10K

15 (out of 835) latents were not identified at rank 1 by any SDK

- ⇨ 3 were missed by all
- ⇨ 7 were missed by 7 SDKs – one SDK identified it at a rank > 1
- ⇨ 2 were missed by 6 SDKs – two SDKs identified it at a rank > 1
- ⇨ 3 were missed by 5 SDKs – three SDKs identified it at a rank > 1

Hardest :: 3 latents missed by all 8 SDKs

	Latent-1	Lantent-2	Latent-3
size	623 x 963	428 x 392	428 x 392
area (%)	25	25	25-50
minutia	10	16	15
finger position	1	7	7
pattern class	RS	LS	RS
core	no	yes	yes
delta left	yes	-	-
delta right	no	yes	-
rotation	ok	ok	ok
clarity	low	low	low
background noise	none	none	none
IAFIS rank (Challenge)	4 (hard+)	5 (hard)	1 (hard)

Harder :: 7 latents missed by 7 SDKs

	Latent-4	Latent-5	Latent-6	Latent-7	Latent-8	Latent-9	Latent-10
size	573x781	248x390	308x516	399x672	350x490	423x516	417x505
area (%)	25	25	25	25	25	25	25
minutia	15	13	16	14	14	13	14
fingerPos	2	2	2	2	6	3	2
pat.Class	WU	LS	LS	RS	LS	RS	RS (tip)
core	yes	yes	yes	no	yes	no	yes
delta left	-	-	-	no	-	yes	no
delta right	no	no	no	-	no	-	no
rotation	ok	ok	ok	ok	ok	ok	ok
clarity	high	medium	low	medium	medium	low	medium
background noise	none	none	none	some	some	none	some
IAFIS rank	3	1	16	3	1	1	20
sdk rank	7	10	3	2	2	7	17

Hard :: 2 latents missed by 6 SDKs

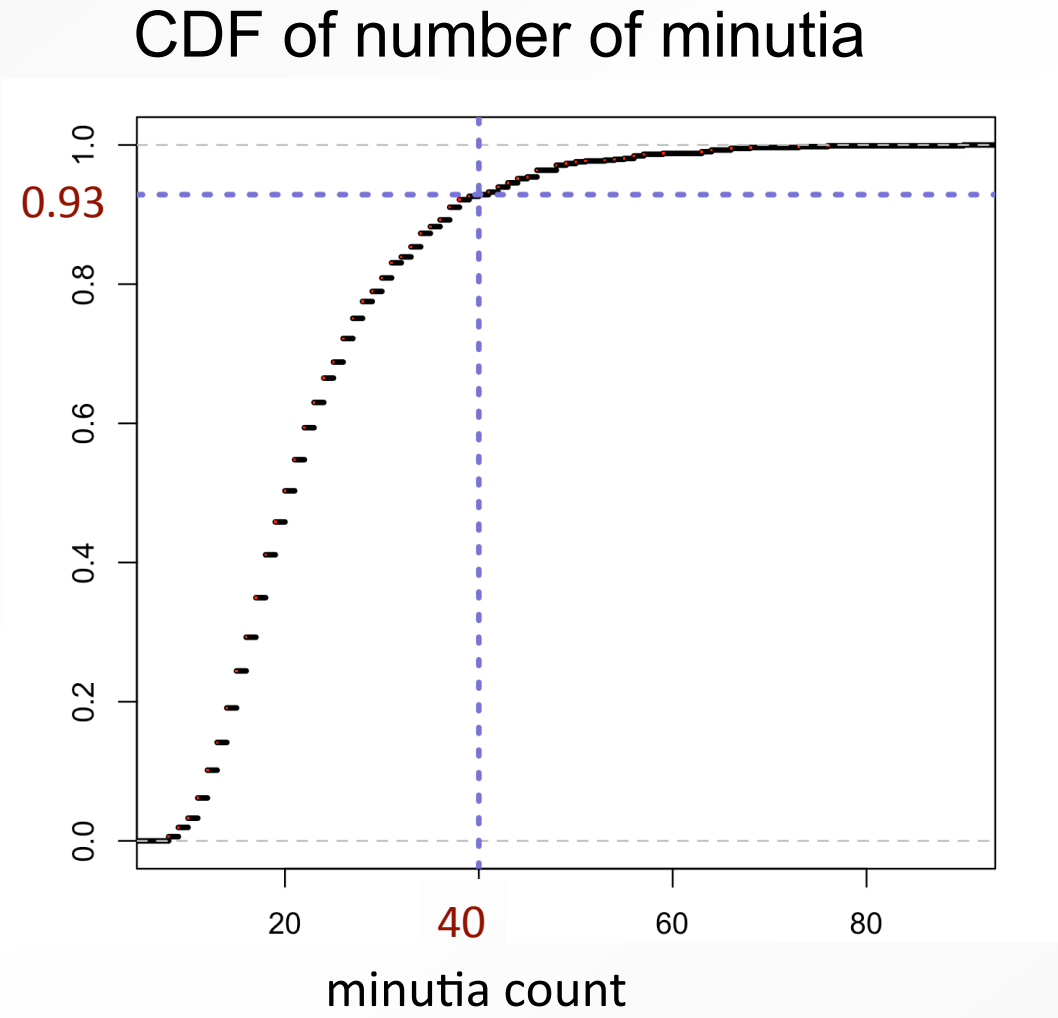
	Latent-11	Latent-12
size	448x580	264x452
area (%)	25	25
minutia	17	12
finger position	3	7
pattern class	RS	UC (side/tip)
core	yes	no
delta left	-	no
delta right	no	no
rotation	ok	ok
clarity	medium	high
background noise	none	none
IAFIS rank	1	1
SDKs rank	39 ; 45	6 ; 32

3 latents missed by 5 SDKs

	Latent-13	Latent-14	Latent-15
size	434x694	370x482	222x346
area (%)	25	25-50	25
minutia	11	17	8
finger position	6	3	9
pattern class	LS	RS	UC (tip)
core	no	yes	no
delta left	-	no	no
delta right	yes	no	no
rotation	ok	ok	ok
clarity	medium	medium	high
background noise	none	none	none
IAFIS rank	7	1	1
SDKs rank	8; 2; 37	34; 19; 19	2; 4; 23

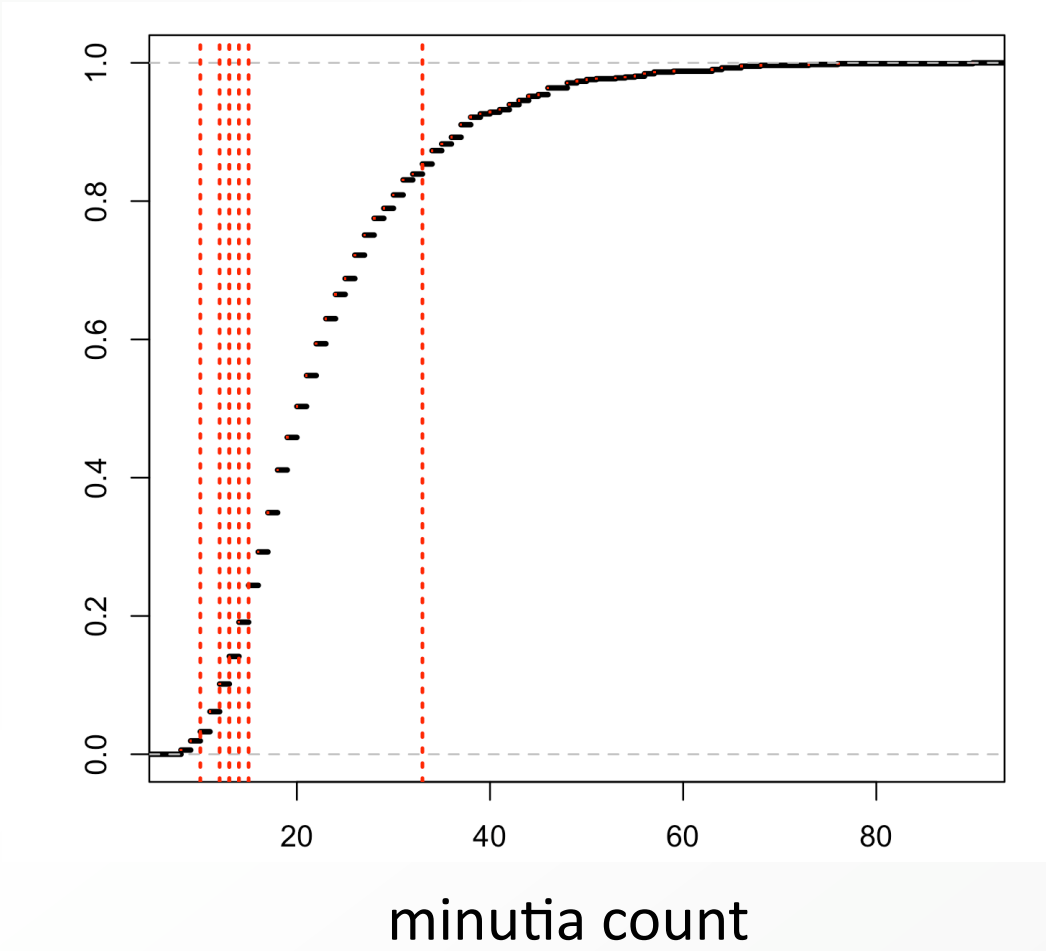
Minutia Count and Rank-1 Hit Rate

Minutia Count and performance

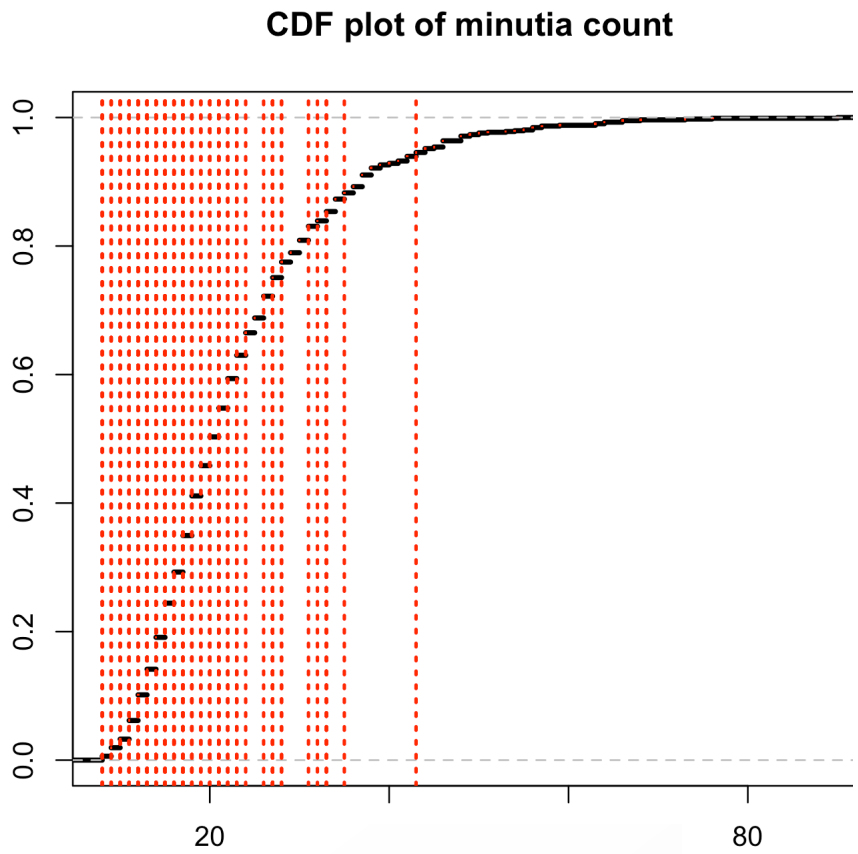


0.93 is the proportion of the latent images that has 40 or fewer minutia.

Minutia Count and performance 1000ppi – Gallery 10K

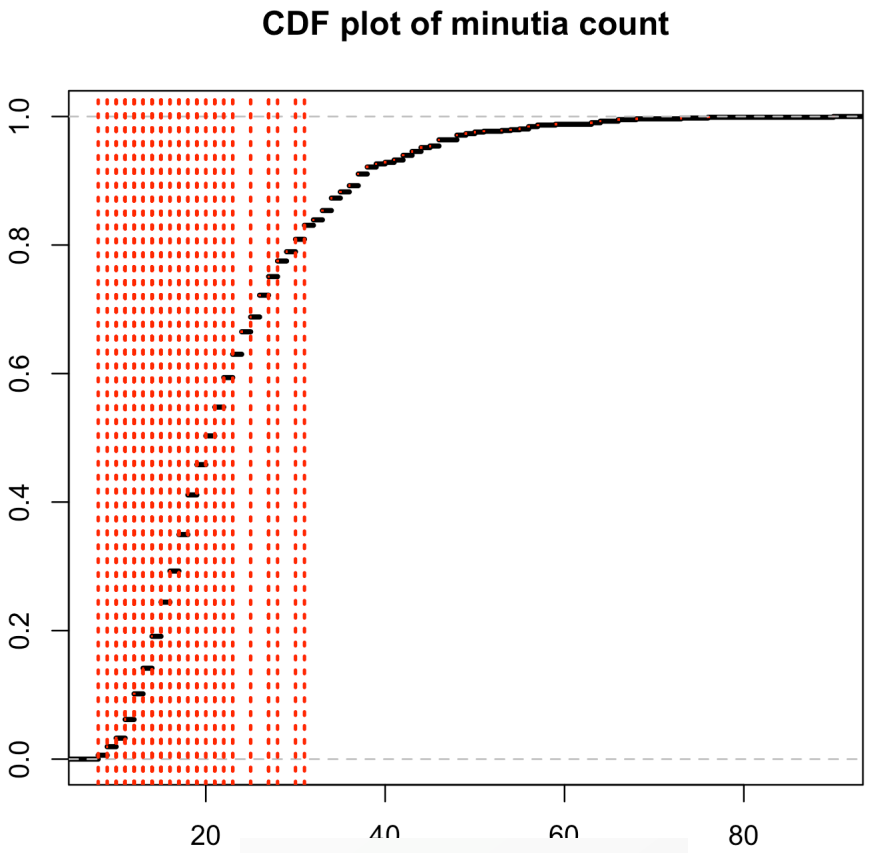


Minutia Count and performance – 2 1000ppi – Gallery 10K



minutia count

SDK_x

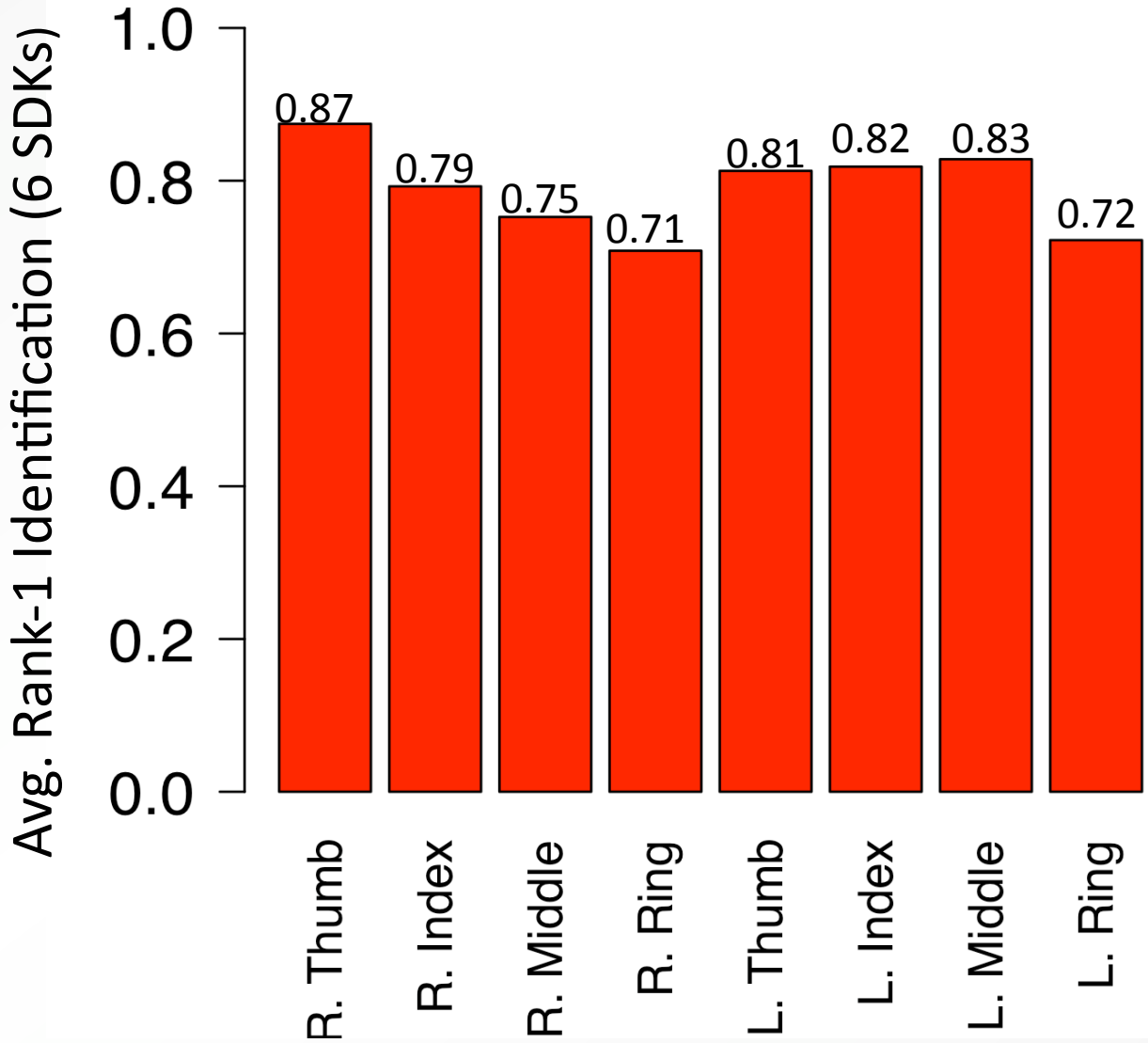


minutia count

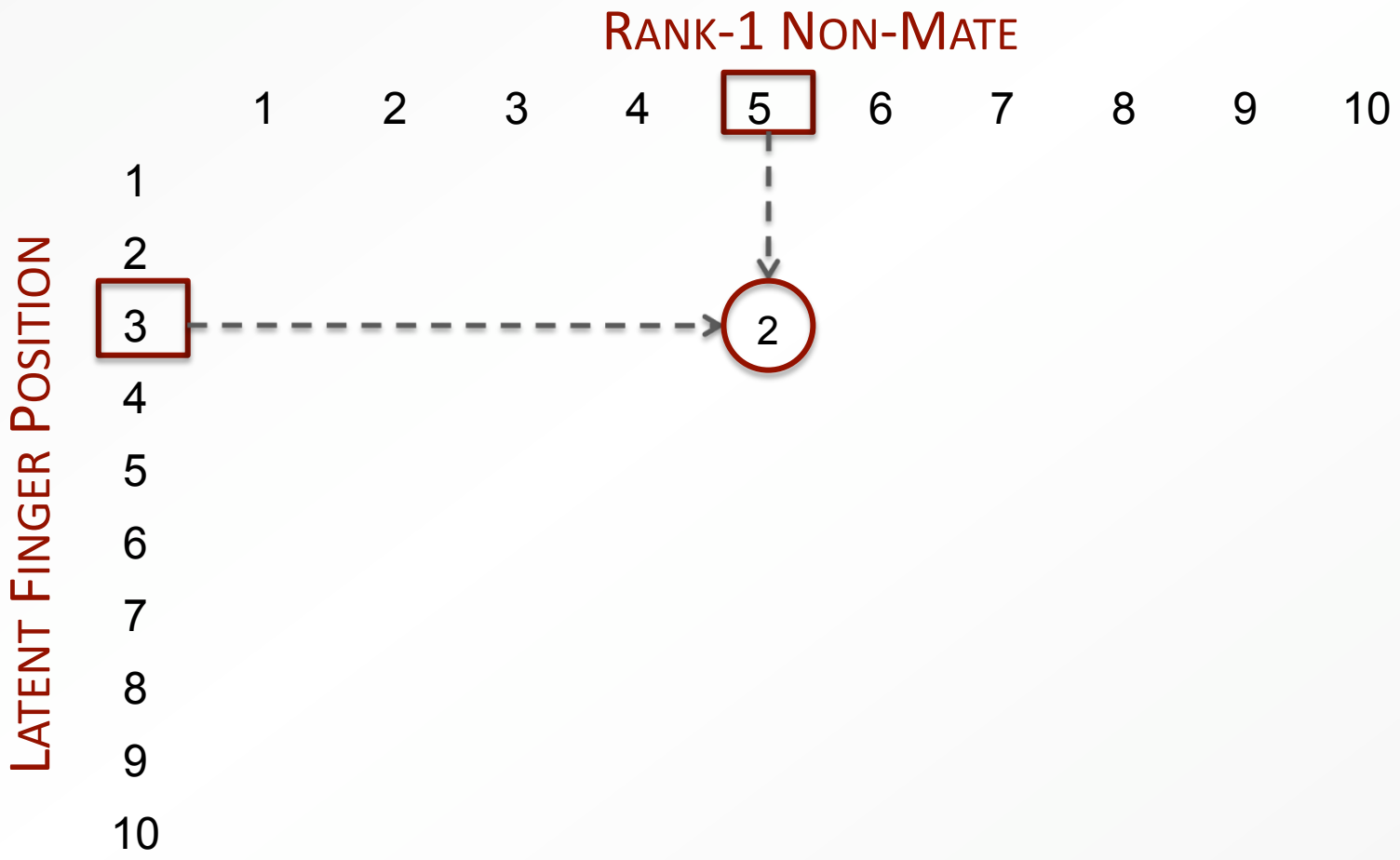
SDK_y

Finger position and Rank-1 Hit Rate

Finger position and performance 1000ppi/gallery 10K



Finger position and performance - 1



Finger position and performance - SDK_x

Latent Finger Position	FTE	Rank-1 Non-Mate 1	2	3	4	5	6	7	8	9	10	Σ	N	cmc
1	-	-	-	1	-	-	-	-	-	-	-	1	247	.99
2	-	1	1	-	1	-	-	-	2	1	1	7	127	.94
3	-	1	-	1	-	2	-	-	-	-	-	4	64	.94
4	-	-	-	-	-	-	-	-	-	-	-	0	20	1.0
5	-	-	-	-	-	-	-	-	-	-	-	0	6	1.0
6	-	-	1	-	-	2	1	-	-	-	2	6	147	.96
7	-	-	-	-	-	1	1	2	-	-	-	4	101	.96
8	-	-	-	-	-	-	-	-	-	-	-	0	64	1.0
9	-	-	-	-	-	-	1	-	-	-	-	1	48	.98
10	-	-	-	-	-	-	-	-	-	-	-	0	11	1.0
Σ	-	2	2	2	1	5	3	2	2	1	3	23		

Finger position and performance - SDK_y

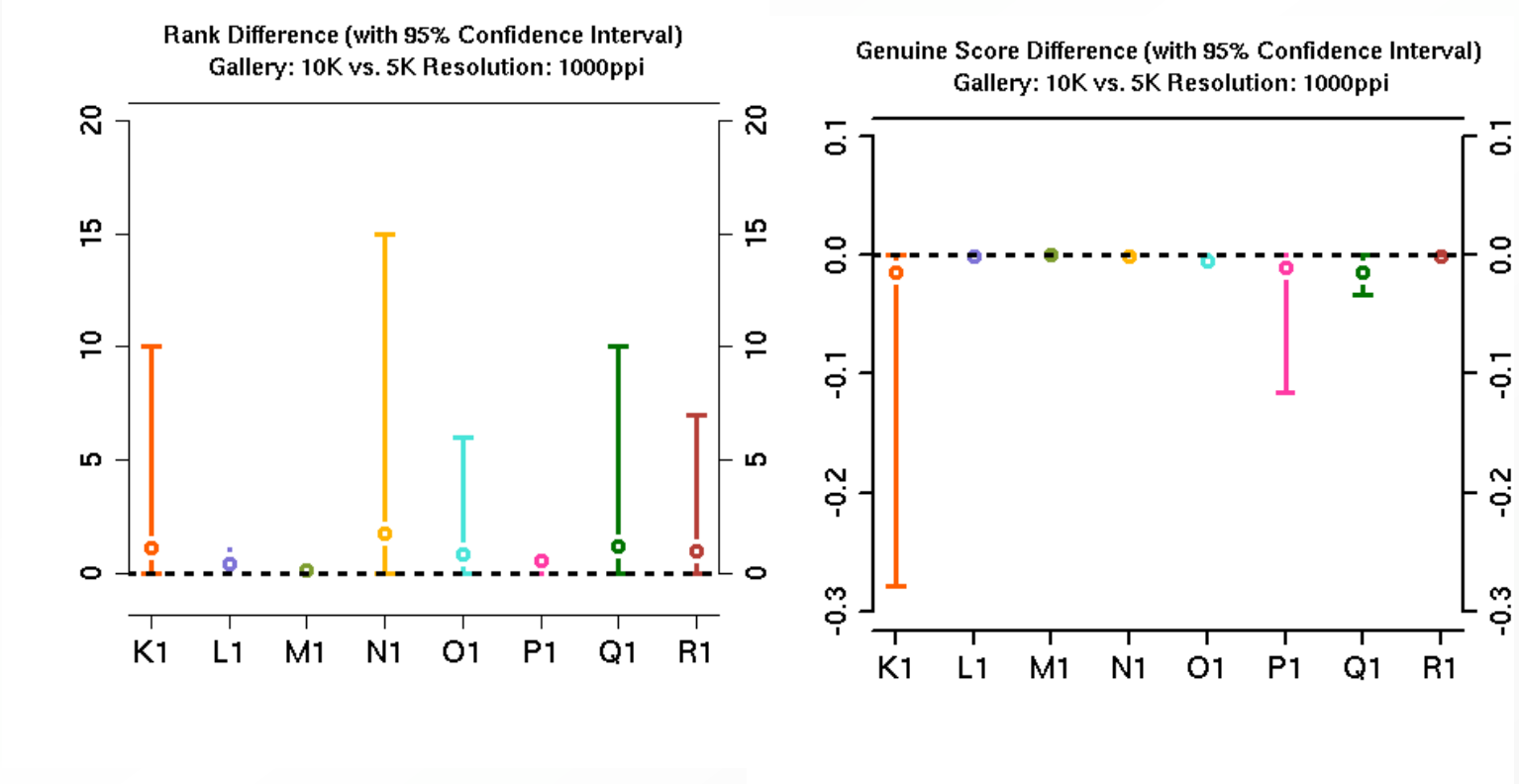
Latent Finger Position	FTE	Rank-1 Non-Mate 1	2	3	4	5	6	7	8	9	10	Σ	N	cmc
1	17	3	2	1	1	1	2	-	-	-	-	27	247	**.89**
2	1	4	1	2	1	2	-	-	1	1	1	14	127	**.89**
3	1	1	1	2	-	-	-	-	1	1	1	8	64	**.87**
4	1	-	1	1	1	-	-	-	1	1	-	6	20	**.70**
5	-	-	-	-	-	-	-	-	1	-	-	1	6	**.83**
6	2	1	1	-	1	3	5	1	-	1	3	18	147	**.88**
7	-	2	1	1	1	-	3	1	2	-	-	11	101	**.89**
8	2	1	-	-	-	-	4	-	-	2	-	9	64	**.86**
9	1	-	1	-	1	-	2	-	-	1	2	8	48	**.83**
10	-	-	-	-	-	-	-	-	-	-	-	0	11	**1.0**
Σ	25	12	8	7	6	6	16	2	6	7	7	102	835	

Finger position and performance - SDK_z

Latent Finger Position	FTE	Rank-1 Non-Mate												
		1	2	3	4	5	6	7	8	9	10	Σ	N	cmc
1	-	1	2	-	3	9	3	2	2	2	9	33	247	**.87**
2	-	-	4	4	4	7	4	2	1	1	7	34	127	**.73**
3	-	1	2	2	1	2	-	-	1	3	5	17	64	**.73**
4	-	1	-	-	-	1	-	1	2	-	-	5	20	**.75**
5	-	-	-	1	-	-	-	-	-	-	-	1	6	**.83**
6	-	2	4	1	3	8	4	4	4	2	4	36	147	**.75**
7	-	1	-	-	1	8	2	2	3	2	1	20	101	**.80**
8	-	1	3	-	2	3	-	1	-	-	1	11	64	**.83**
9	-	1	2	1	2	5	-	3	1	2	1	18	48	**.63**
10	-	-	-	-	-	-	1	-	-	-	1	2	11	**0.82**
Σ	-	8	17	9	16	43	14	15	14	12	29	177	835	

Effect of Gallery Size

Effect of Gallery size



There is a very small but perhaps significant difference between genuine comparison scores (and rank) of searches with 10K and 5K gallery size.

False positive identification

- Number of candidate lists after thresholding at t, which should be empty but are not / Number of searches.
  - No latent caused false positive for *all* sdks
  - Median minutia count for false positives are about the same as median minutia count for the whole test dataset
  - Ink and live impressions evenly contributed to false positives

Closing remarks

- Number of minutia is a proxy for level of difficulty of a latent.
  - The lower the number of minutia, the higher the likelihood of a false negative identification.
  - number of minutia of latents result in false positive are about the median of number of minutia of the test set.
- Finger position: right thumb and right index seems to be more accurate
- Gallery size is a factor affecting performance
- No apparent trend for false positives
- The results/observations has to be verified by a much bigger sample size.

upcoming attraction

BQUTE

Biometric Quality Test and Evaluation

- Latent image
  - Scalar latent image quality
  - Latent image quality map

Comments are most welcome.

Thanks

elham.tabassi@nist.gov

301 975 5292