

# Was wird in öfftl. Performanztests wie dem Fingerprint Verification Competition getestet?



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# Fingerprint Verification Competition

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- Was ist die FVC?
- FVC2000
- FVC2002
- FVC2004
- FVC2006
- FVC onGoing
- Diskussion

# Fingerprint Verification Competition

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Was ist die FVC?

# Fingerprint Verification Competition - Was ist die FVC?

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- Ins Leben gerufen von
  - University of Bologna
  - San José State University
  - Michigan State University
  - Universidad Autonoma de Madrid
- Vergleich von AFIS
- Besseres Verständnis der Technologie durch Industrie und akademischen Bereich
- Größere Verbreitung der Ergebnisse durch offene Competition

## Fingerprint Verification Competition - Was ist die FVC?

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- Start 2000
- Weitere 2002, 2004 und 2006 beendet
- Laufende Competition mit neuer Datenbank-Klassifizierung
- Neue Datenbanken angelegt
- C-Skeletons für Enrollment und Matching verfügbar
- Config-File für jede DB

# Fingerprint Verification Competition - Was ist die FVC?

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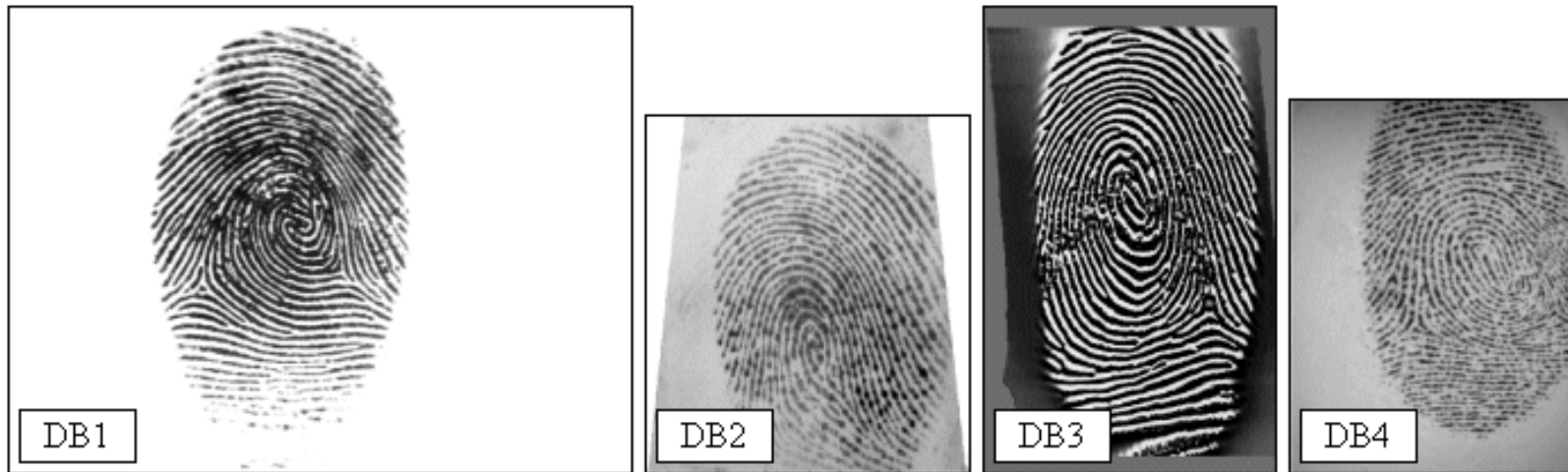
- 4 Datenbanken
- Teilung für Performance und Tuning für Teilnehmer
- Synthetisch mit Software SFinGe

Database	FVC2000	FVC2002	FVC2004	FVC2006
DB1	Optical	Optical	Optical	Electric
DB2	Capacitive	Optical	Optical	Optical
DB3	Optical	Capacitive	Thermal	Thermal
DB4	Synthetic	Synthetic	Synthetic	Synthetic

## Fingerprint Verification Competition - Was ist die FVC?

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- 4 Datenbanken
- Teilung für Performance und Tuning für Teilnehmer
- Synthetisch mit Software SFinGe



# Fingerprint Verification Competition

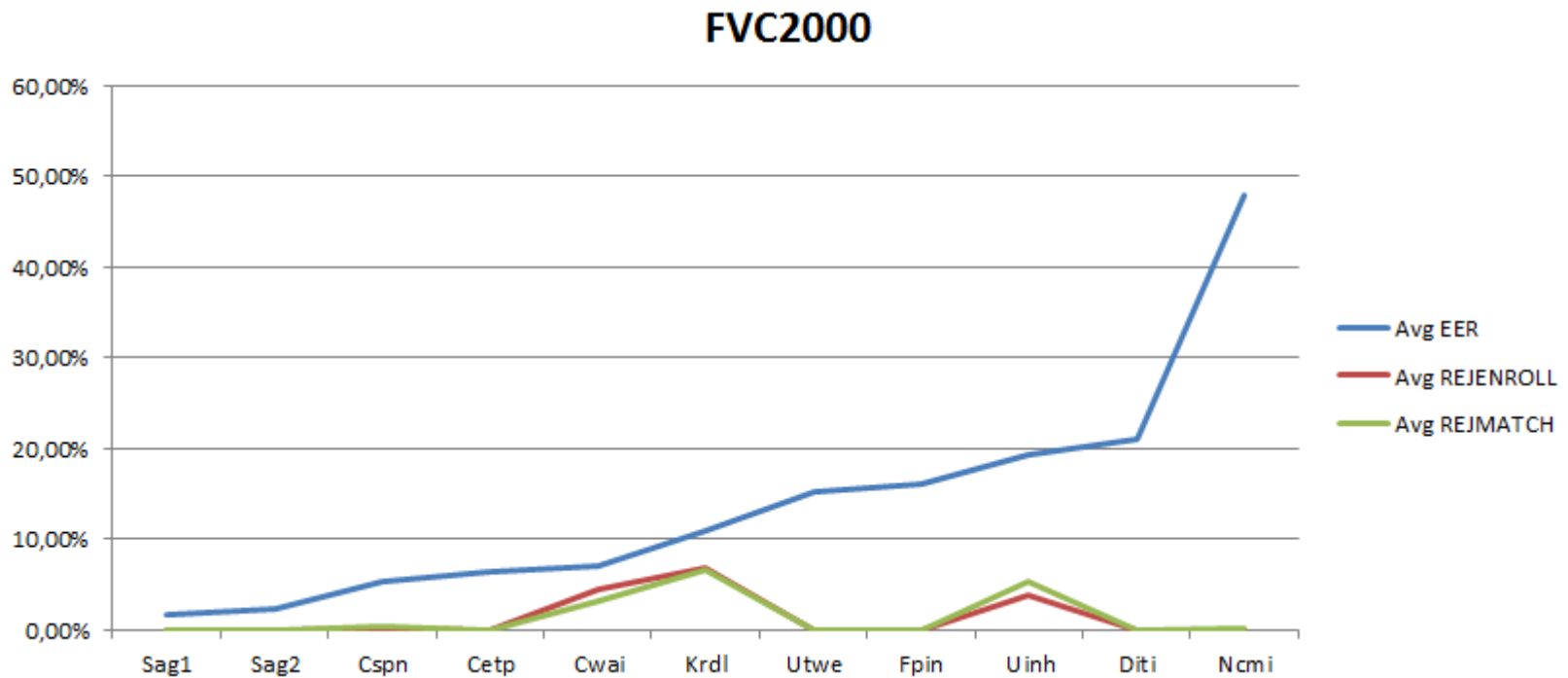
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**FVC2000**



# Fingerprint Verification Competition – FVC2000

- 11 Algorithmen
- Beste durchschnittliche EER: 1,73%
- Median durchschnittliche EER: 10,94%



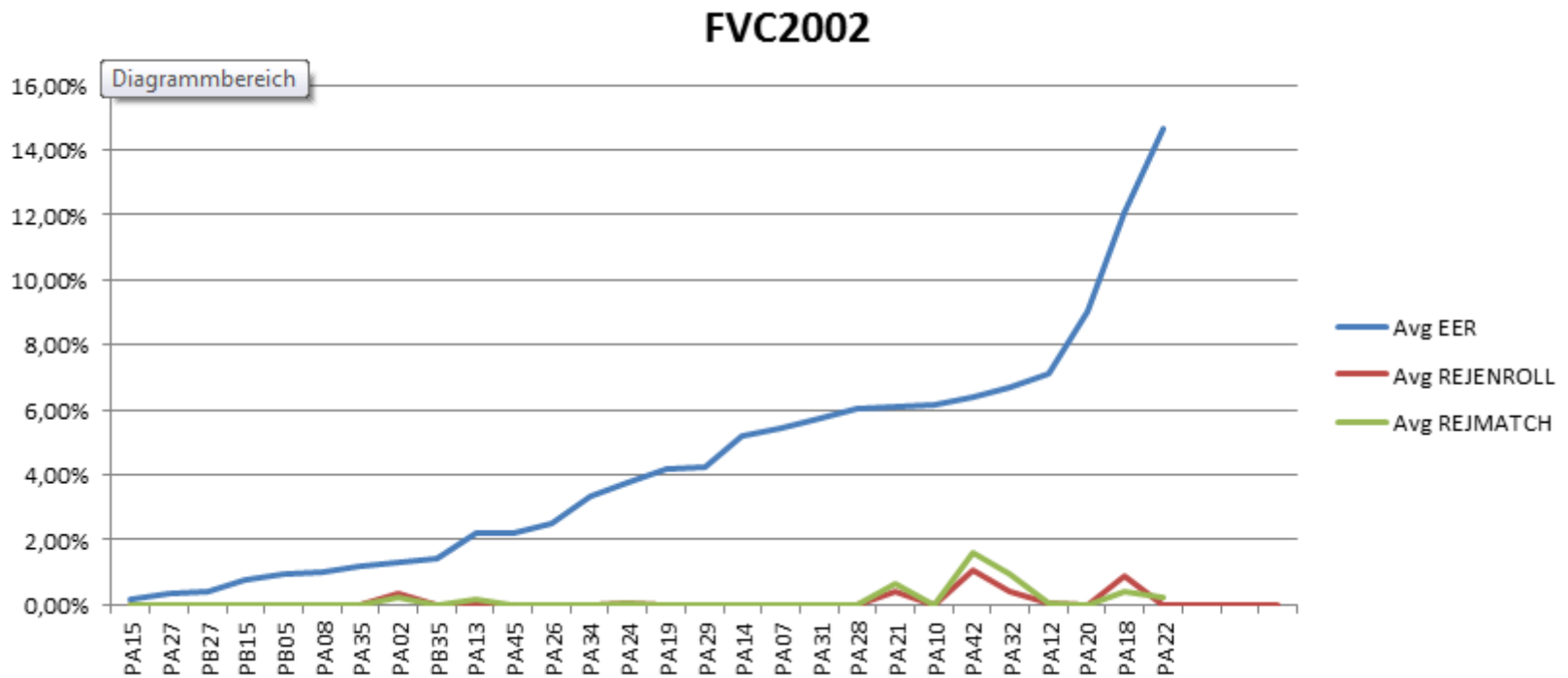
# Fingerprint Verification Competition

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**FVC2002**

# Fingerprint Verification Competition – FVC2002

- 31 Algorithmen
- Beste durchschnittliche EER: 0,19%
- Median durchschnittliche EER: 4,24%



# Fingerprint Verification Competition

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FVC2004

# Fingerprint Verification Competition – FVC2004

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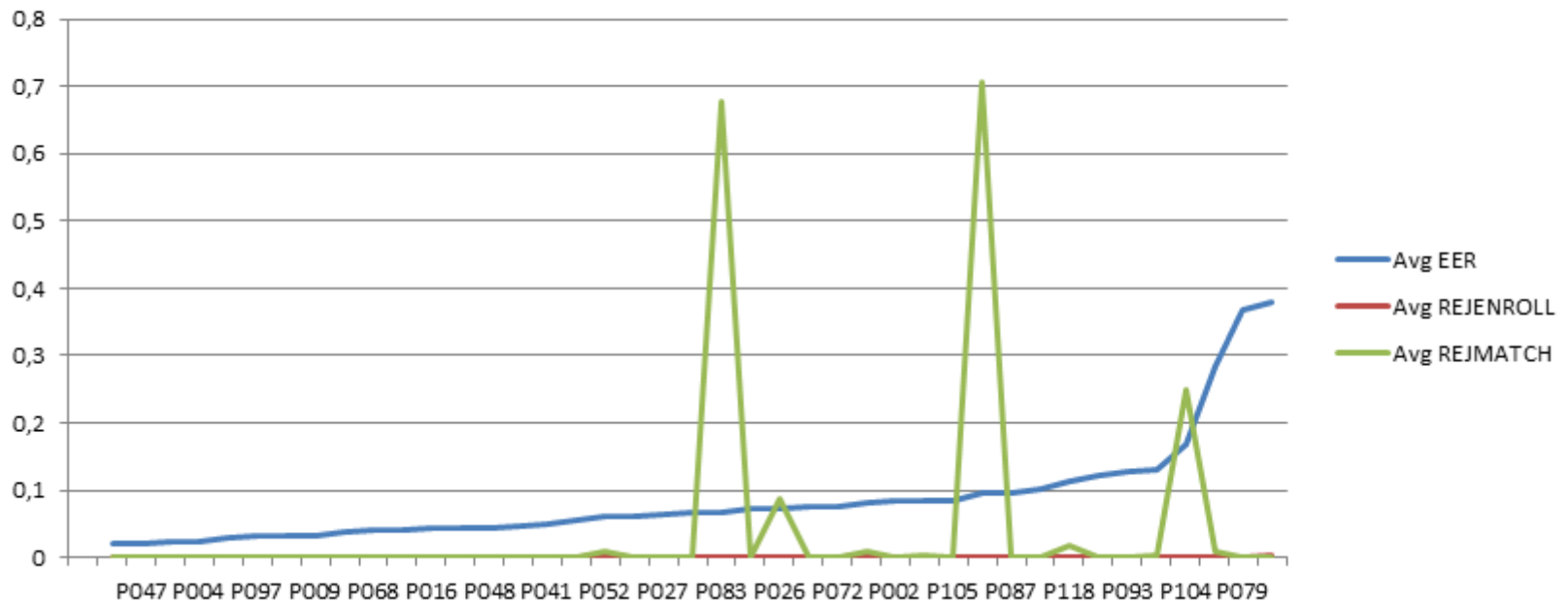
- Unterteilung in Open und Light Category
- Open Category:
- Light Category

	Open category	Light Category
<b>Enroll time limit</b>	10 seconds	0.5 seconds
<b>Match time limit</b>	5 seconds	0.3 seconds
<b>Model size limit</b>	<i>No limit</i>	2 KBytes
<b>Allocated memory limit</b>	<i>No limit</i>	4 MBytes

# Fingerprint Verification Competition – FVC2004 Open Category

- 41 Algorithmen
- Beste durchschnittliche EER: 2,07%
- Median durchschnittliche EER: 6,56%

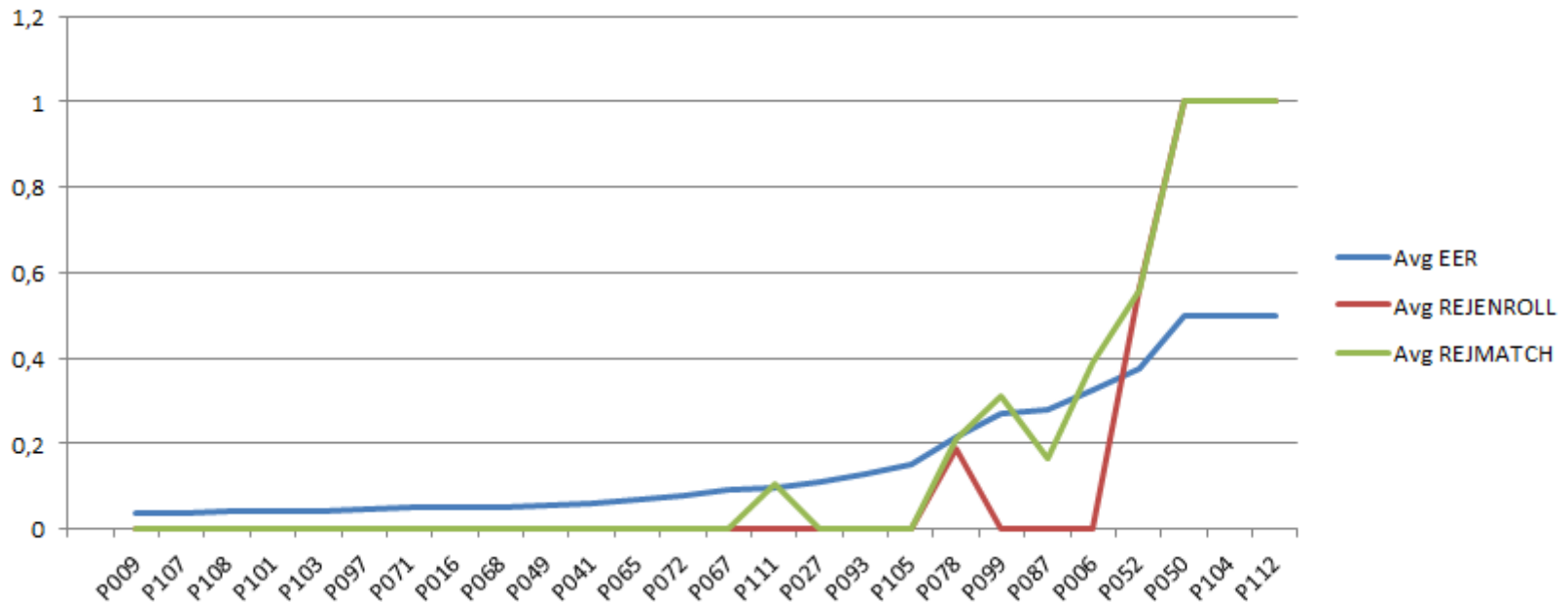
FVC2004 Open Category



# Fingerprint Verification Competition – FVC2004 Light Category

- 26 Algorithmen
- Beste durchschnittliche EER: 3,51%
- Median durchschnittliche EER: 9,05%

FVC2004 Light Category



# Fingerprint Verification Competition

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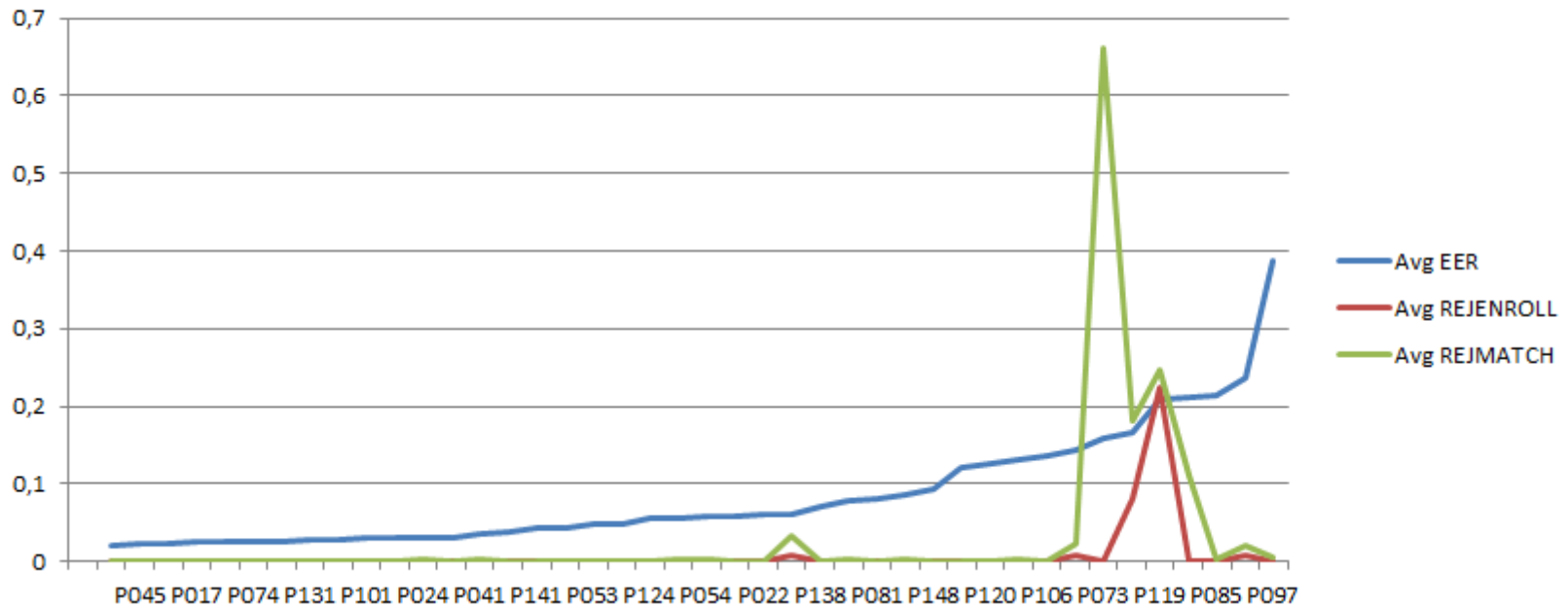
**FVC2006**



# Fingerprint Verification Competition – FVC2006 Open Category

- 44 Algorithmen
- Beste durchschnittliche EER: 2,15%
- Median durchschnittliche EER: 5,80%

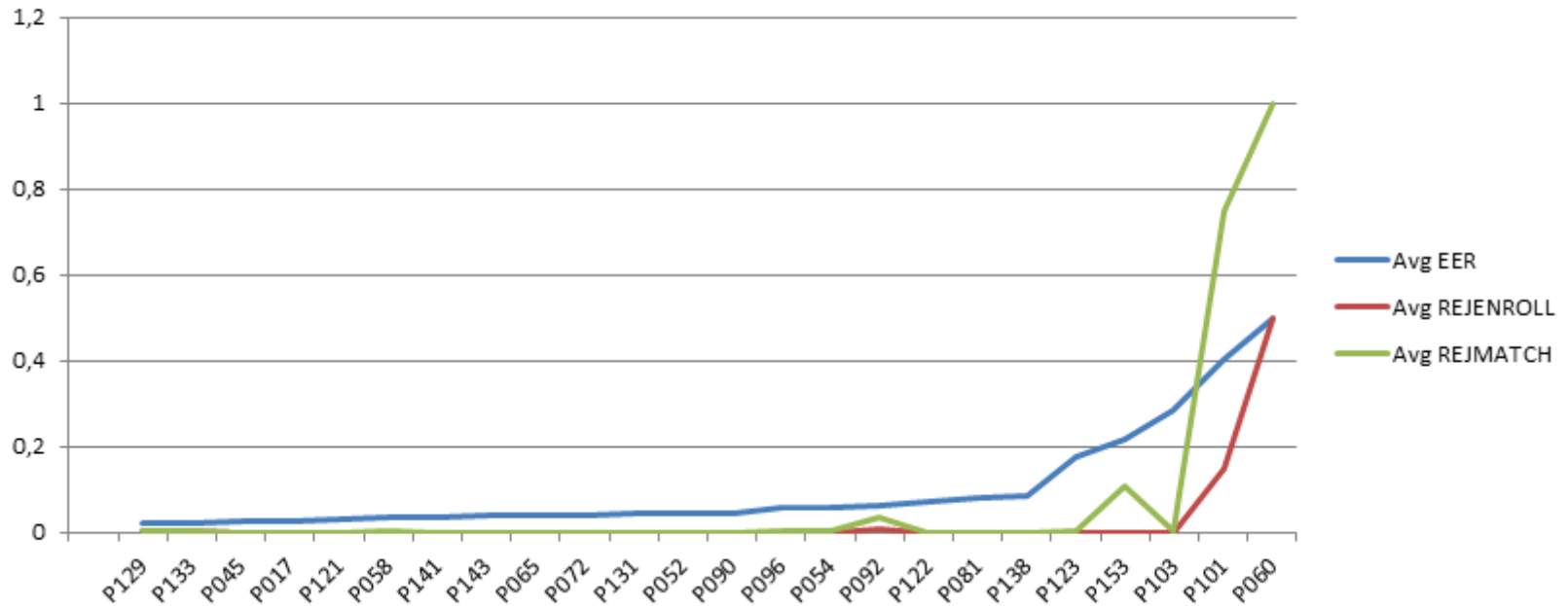
FVC2006 Open Category



# Fingerprint Verification Competition – FVC2006 Light Category

- 26 Algorithmen
- Beste durchschnittliche EER: 1,92%
- Median durchschnittliche EER: 4,50%

FVC2006 Light Category



# Fingerprint Verification Competition

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FVC onGoing

# Fingerprint Verification Competition – FVC onGoing

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- 1908 Algorithmen
- 85 Ergebnisse veröffentlicht
- 6 Benchmark-Areas (DB-Ersatz)
  - Fingerprint Verification
  - Palmprint Verification
  - Fingerprint Matching (ISO)
  - Fingerprint Indexing
  - Fingerprint Orientation Extraction
  - Secure Template Fingerprint Verification

## Fingerprint Verification

Vergleich von zwei Fingerabdrücken

- **FV-TEST:** Datensätze um Testprotokoll zu testen
- **FV-STD-1.0:** hochauflösende Fingerabdruckbilder
- **FV-HARD-1.0:** nicht wenige schwierige Bilder (Rauschen, deformierte Bilder, ...)

## Fingerprint Verification Competition – FVC onGoing

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### Fingerprint Verification

Benchmark	Scanner Type	Resolution	Minimum Image Size	Maximum Image Size	Genuine Attempts	Impostor Attempts
FV-TEST	Optical	500 dpi	440x500	440x500	280	45
FV-STD-1.0	Optical	500 dpi	440x500	440x500	27720	87990
FV-HARD-1.0	Optical	500 dpi	260x374	448x500	19320	20850

# Fingerprint Verification Competition – FVC onGoing

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## Fingerprint Verification

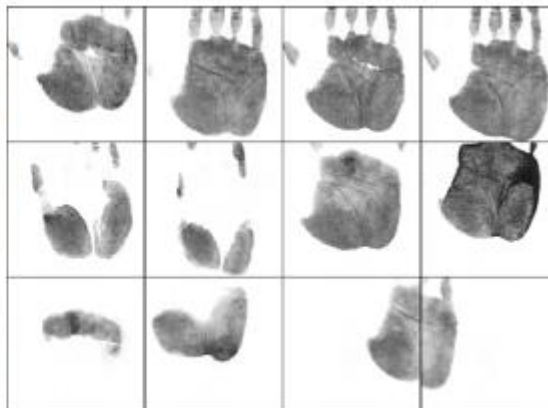
Benchmark	Maximum time for each enroll	Maximum time for each match	Maximum template size	Memory allocation limit for enroll and match processes
FV-TEST	5 seconds	3 seconds	No limit	No limit
FV-STD-1.0	5 seconds	3 seconds	No limit	No limit
FV-HARD-1.0	5 seconds	3 seconds	No limit	No limit

Benchmark	Minimum break
FV-TEST	12 hour(s)
FV-STD-1.0	30 day(s)
FV-HARD-1.0	30 day(s)

## Palmpoint Verification

Vergleich von zwei Handabdrücken

- ❑ **PV-TEST-FULL:** Datensätze um Testprotokoll zu testen
- ❑ **PV-TEST-PARTIAL:** Datensätze um Testprotokoll zu testen
- ❑ **PV-FULL-1.0:** volle Bilder von Handabdrücken
- ❑ **PV-PARTIAL-1.0:** volle und partielle Bilder von Handabdrücken





# Fingerprint Verification Competition – FVC onGoing

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## Palmpoint Verification

Benchmark	Scanner Type	Resolution	Minimum Image Size	Maximum Image Size	Genuine Attempts	Impostor Attempts
PV-TEST-FULL	Optical	500 dpi	2552x2500	2552x2500	280	45
PV-TEST-PARTIAL	Optical	500 dpi	416x1632	1704x1744	40	360
PV-FULL-1.0	Optical	500 dpi	2552x2500	2552x2500	2800	4950
PV-PARTIAL-1.0	Optical	500 dpi	688x768	2552x2496	400	10000

# Fingerprint Verification Competition – FVC onGoing

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## Palmpoint Verification

Benchmark	Maximum time for each enroll	Maximum time for each match	Maximum template size	Memory allocation limit for enroll and match processes
PV-TEST-FULL	90 seconds	10 seconds	No limit	No limit
PV-TEST-PARTIAL	90 seconds	5 seconds	No limit	No limit
PV-FULL-1.0	90 seconds	10 seconds	No limit	No limit
PV-PARTIAL-1.0	90 seconds	5 seconds	No limit	No limit

Benchmark	Minimum break
PV-TEST-FULL	12 hour(s)
PV-TEST-PARTIAL	12 hour(s)
PV-FULL-1.0	30 day(s)
PV-PARTIAL-1.0	30 day(s)

## Fingerprint Verification Competition – FVC onGoing

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### □ Fingerprint Matching (ISO)

Fingerabdruckvergleiche mit standardisiertem Minuten-basierten Template-Format

- **FMISO-TEST:** Datensätze um Testprotokoll zu testen
- **FMISO-STD-1.0:** ISO-Templates aus hochauflösende Fingerabdruckbildern
- **FMISO-HARD-1.0:** nicht wenige ISO-Templates aus schwierigen Bilder (Rauschen, deformierte Bilder, ...)

## Fingerprint Verification Competition – FVC onGoing

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### □ Fingerprint Matching (ISO)

Benchmark	Scanner Type	Resolution	Minimum Template Size	Maximum Template Size	Genuine Attempts	Impostor Attempts
FMISO-TEST	Optical	500 dpi	440x500	440x500	280	45
FMISO-STD-1.0	Optical	500 dpi	440x500	440x500	27720	87990
FMISO-HARD-1.0	Optical	500 dpi	260x374	448x500	19320	20850

# Fingerprint Verification Competition – FVC onGoing

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## □ Fingerprint Matching (ISO)

Benchmark	Maximum time for each match	Memory allocation limit for match process
FMISO-TEST	3 seconds	No limit
FMISO-STD-1.0	3 seconds	No limit
FMISO-HARD-1.0	3 seconds	No limit

Benchmark	Minimum break
FMISO-TEST	12 hour(s)
FMISO-STD-1.0	30 day(s)
FMISO-HARD-1.0	30 day(s)

## Fingerprint Indexing

Fingerabdrucksuche in großen Datenbanken

- **FIDX-TEST:** Datensätze um Testprotokoll zu testen
- **FIDX-10K-1.0:** 10.000 FA in DB, 100 Suchen, alle vorhanden
- **FMISO-HARD-1.0:** 50.000 FA in DB, 500 Suchen

## Fingerprint Verification Competition – FVC onGoing

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### Fingerprint Indexing

Benchmark	Scanner Type	Resolution	Image Size	Indexed Images	Searched Images
FIDX-TEST	Optical	500 dpi	400x500	100	10
FIDX-10K-1.0	Optical	500 dpi	400x500	10000	100
FIDX-50K-1.0	Optical	500 dpi	400x500	50000	500

# Fingerprint Verification Competition – FVC onGoing

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## Fingerprint Indexing

Benchmark	Maximum test execution time
FIDX-TEST	1 minute
FIDX-10K-1.0	60 minutes
FIDX-50K-1.0	300 minutes

Benchmark	Minimum break
FIDX-TEST	12 hour(s)
FIDX-10K-1.0	30 day(s)
FIDX-50K-1.0	30 day(s)



## Fingerprint Orientation Extraction

### Orientierungsextraktion

- **FOE-TEST:** Datensätze um Testprotokoll zu testen
- **FOE-STD-1.0:** Datensätze bezüglich Orientierung, Vergleich der Ergebnisse mit vorgegebener Orientierung

# Fingerprint Verification Competition – FVC onGoing

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## Fingerprint Orientation Extraction

Benchmark	Scanner Type	Resolution	Minimum Image Size	Maximum Image Size	Good Quality Dataset		Bad Quality Dataset	
					Orientation Estimations	Finger prints	Orientation Estimations	Finger prints
FOE-TEST	Optical	500 dpi	328x364	448x560	18946	10	75812	50
FOE-STD-1.0	Optical	500 dpi	328x364	448x560	19260	10	89562	50

# Fingerprint Verification Competition – FVC onGoing

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## Fingerprint Orientation Extraction

Benchmark	Maximum processing time for each fingerprint	Maximum Allowed Average Error on the Good Quality Dataset
FOE-TEST	10 seconds	7 degrees
FOE-STD-1.0	10 seconds	7 degrees

Benchmark	Minimum break
FOE-TEST	2 hour(s)
FOE-STD-1.0	1 day(s)

# Secure Template Fingerprint Verification

Verschlüsselte Templates verglichen mit Fingerabdruck

- **STFV-TEST:** Datensätze um Testprotokoll zu testen
- **STFV-STD-1.0:** hochauflösende Fingerabdruckbilder
- **STFV-HARD-1.0:** nicht wenige schwierigen Fingerabdruckbilder (Rauschen, deformierte Bilder, ...)

## Fingerprint Verification Competition – FVC onGoing

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### Secure Template Fingerprint Verification

Benchmark	Scanner Type	Resolution	Minimum Image Size	Maximum Image Size	Genuine Attempts	Impostor Attempts
STFV-TEST	Optical	500 dpi	440x500	440x500	280	45
STFV-STD-1.0	Optical	500 dpi	440x500	440x500	27720	87990
STFV-HARD-1.0	Optical	500 dpi	260x374	448x500	19320	20850

# Fingerprint Verification Competition – FVC onGoing

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## Secure Template Fingerprint Verification

Benchmark	Maximum time for each enroll	Maximum time for each match	Maximum template size	Memory allocation limit for enroll and match processes
STFV-TEST	15 seconds	5 seconds	No limit	No limit
STFV-STD-1.0	15 seconds	5 seconds	No limit	No limit
STFV-HARD-1.0	15 seconds	5 seconds	No limit	No limit

Benchmark	Minimum break
STFV-TEST	12 hour(s)
STFV-STD-1.0	30 day(s)
STFV-HARD-1.0	30 day(s)

# Fingerprint Verification Competition

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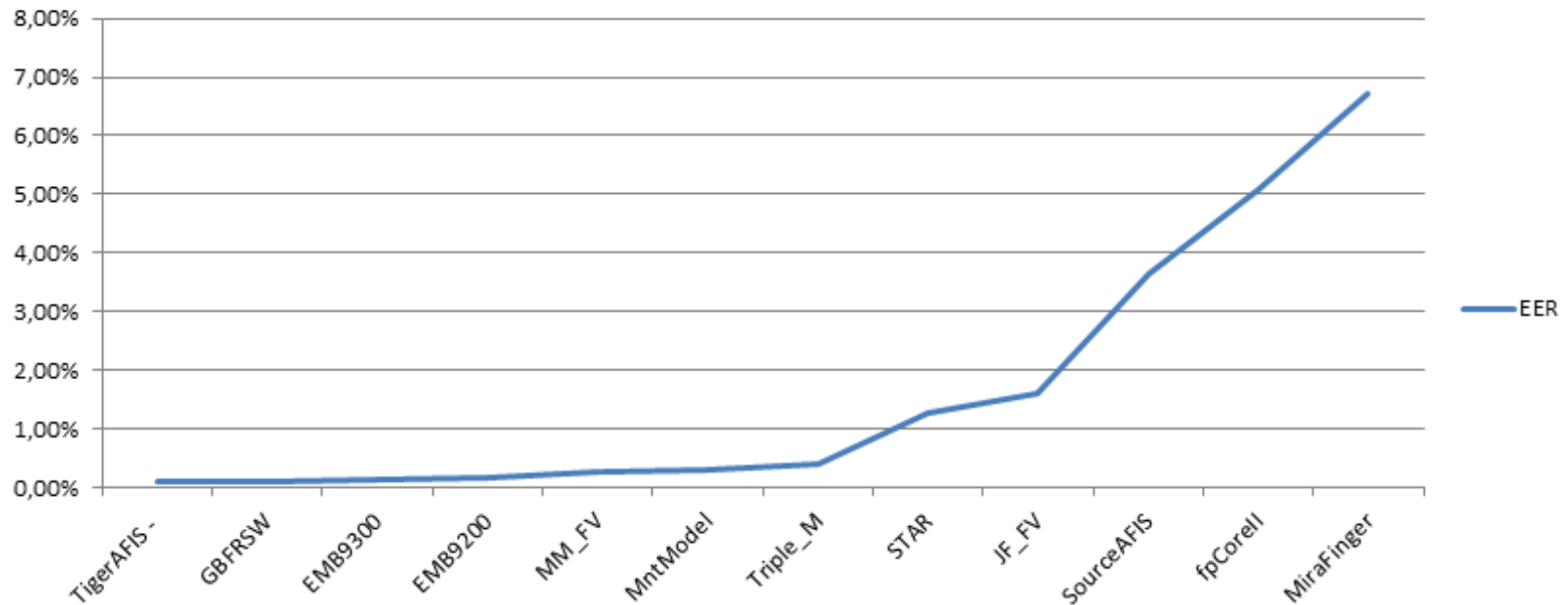
## □ Aktuell

Algorithms Evaluated by Benchmark Area	
Fingerprint Matching (ISO)	949
Secure Template Fingerprint Verification	23
Fingerprint Verification	751
Fingerprint Orientation Extraction	91
Palmprint Verification	54

# Fingerprint Verification Competition – FVC onGoing

- 12 Algorithmen
- Beste durchschnittliche EER: 0,11%
- Median durchschnittliche EER: 0,29%

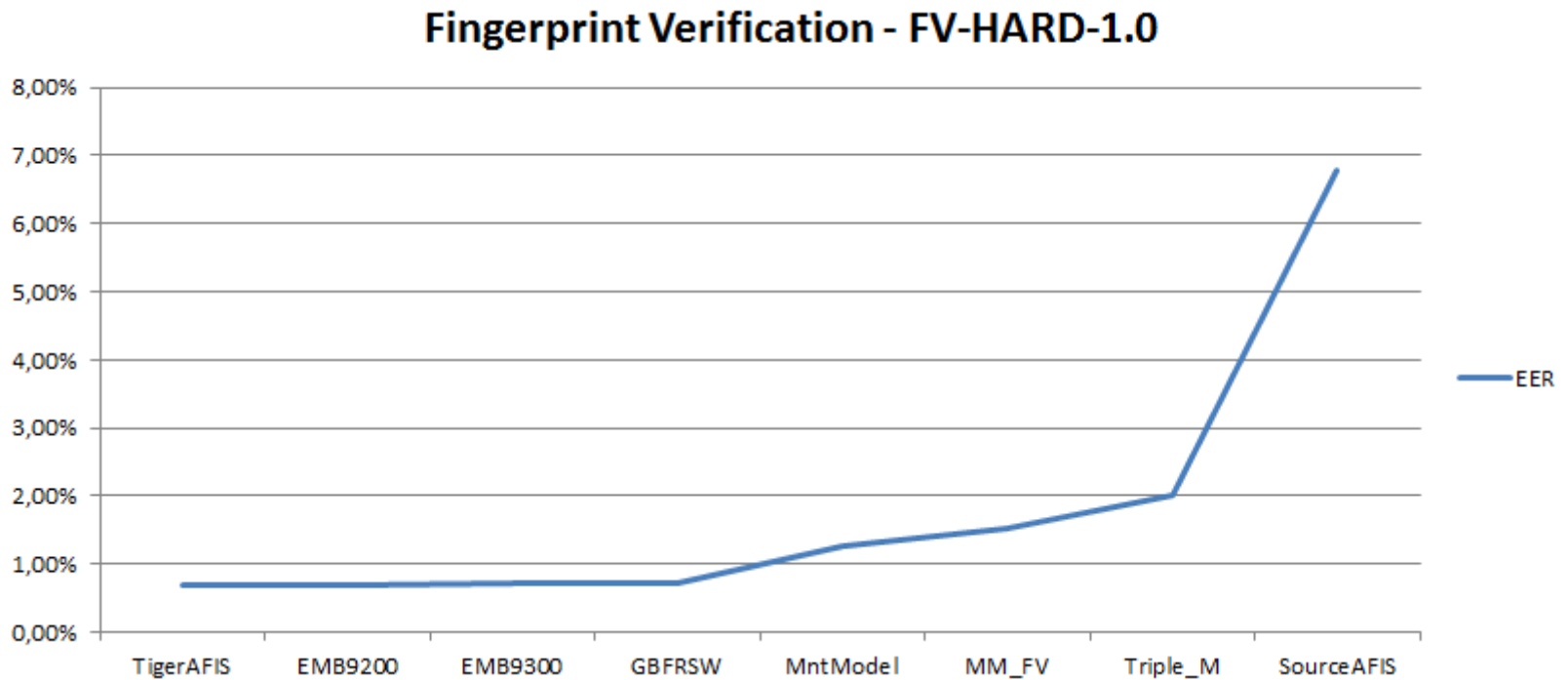
Fingerprint Verification - FV-STD-1.0





# Fingerprint Verification Competition – FVC onGoing

- 8 Algorithmen
- Beste durchschnittliche EER: 0,69%
- Median durchschnittliche EER: 0,74%



# Fingerprint Verification Competition

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## Diskussion

## Fingerprint Verification Competition – Diskussion

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Was sind die Implikationen der FVC?  
Was könnte man verbessern?

# Fingerprint Verification Competition – Diskussion

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## Quellen

- <https://biolab.csr.unibo.it/FvcOnGoing/UI/Form/Home.aspx>
- <http://bias.csr.unibo.it/fvc2006/>
- <http://bias.csr.unibo.it/fvc2004/>
- <http://bias.csr.unibo.it/fvc2002/>
- <http://bias.csr.unibo.it/fvc2000/>