Focussing the Beam - A New Laser Illumination Based Data Set Providing Insights to Finger-Vein Recognition

Christof Kauba, **Bernhard Prommegger** and Andreas Uhl

Universität Salzbug
Department of Computer Sciences
A-5020 Salzburg, Austria

23 October 2018

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Finger Vein Authentication

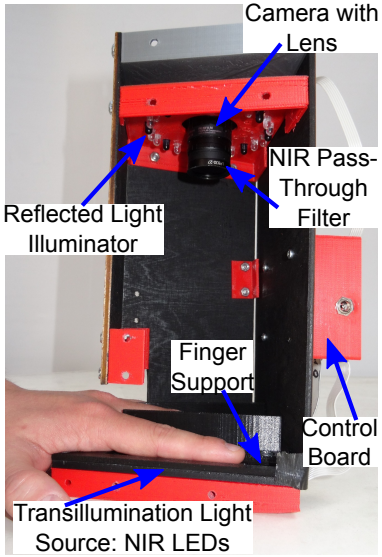
- Pattern formed by the blood vessels inside the finger has become an emerging biometric trait
- Blood vessels are underneath the skin and only visible in near-infrared light
- Vein pattern is resistant to (direct) forgery, liveness detection is easy
- Neither sensitive to finger surface conditions nor to abrasion
- Commercial scanners: palmar images using light transmission

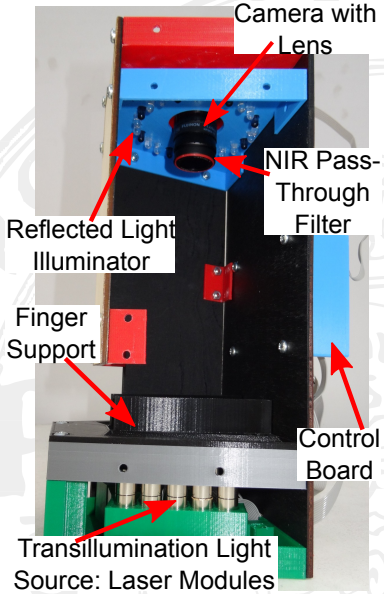
Problem

- Only a few finger vein data sets publicly available
- No publicly available dorsal finger vein data set
- No fully open source finger vein scanner design available

PLUS OpenVein - Open Source Finger Vein Scanner

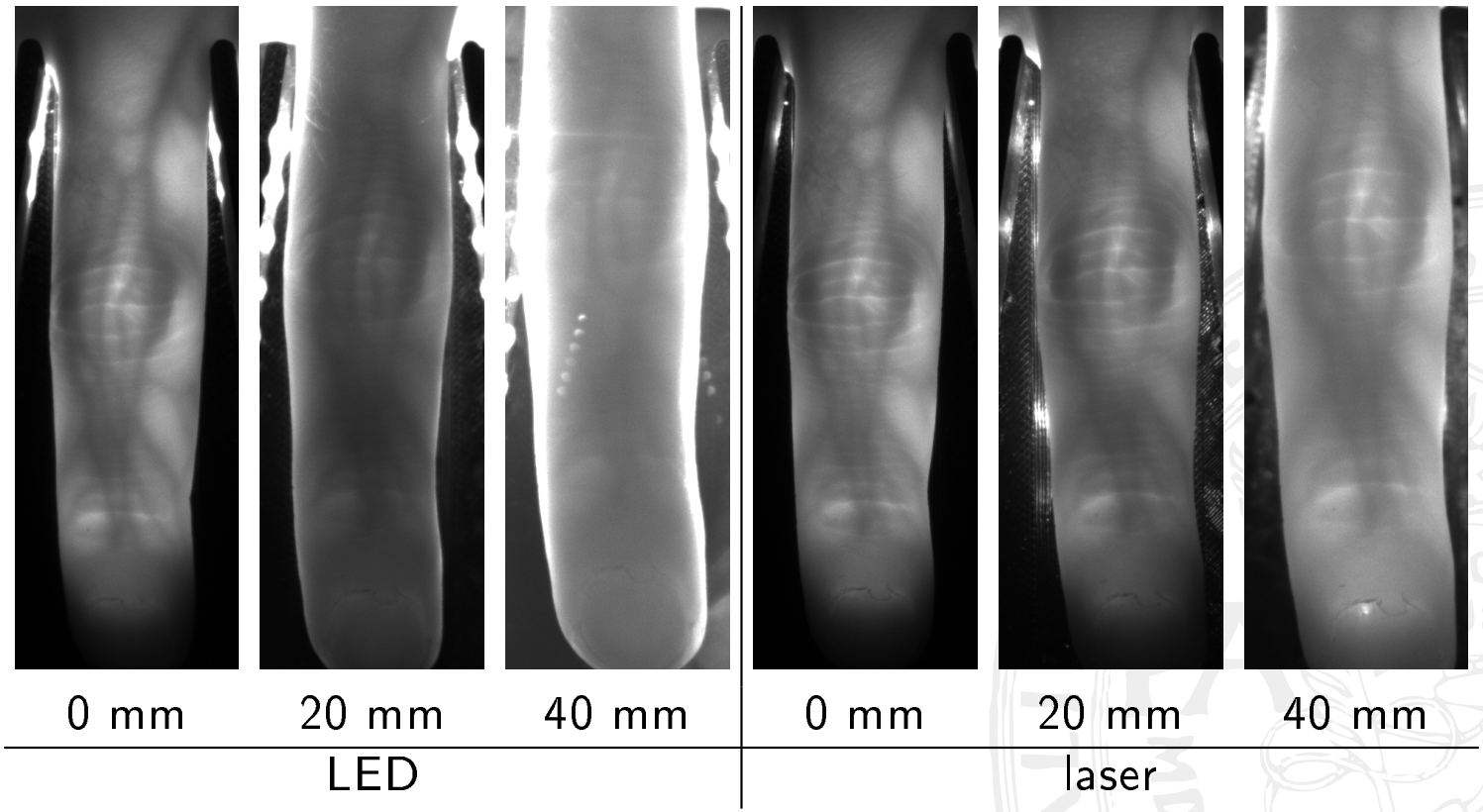
- NIR LED (left) and laser module based version (right)
- Acquires three fingers simultaneously (speed-up + prevent finger rotation)
- Light transmission and reflected light + dorsal and palmar
- Automated illuminator intensity control to achieve optimal image contrast
- Based on a flexible and modular design, details will be made open source soon





Advantages of Laser Modules over LEDs

- Less bright areas along the finger outlines
- Contrast remains high even if the distance between the illuminator and the finger is increased
- Advantages in contactless operation (see next presentation)
  - Multi-perspective finger-vein scanner based on laser modules [7]



PLUSVein-FV3 Data Set

- First publicly available dorsal finger vein data set
- 60 subjects, 35 male, 25 female, from 18 to 79 years old
- 6 fingers per subject $\rightarrow$ 360 individual fingers
- 5 dorsal images per finger, 1 session $\rightarrow$ 1800 images per scanner
- 2 scanners $\rightarrow$ 3600 images in total
- Image size: 420×1024 pixels, visible finger size: 200×750 pixels
- Has been extended by a palmar subset (same subjects) [2] $\rightarrow$ 7200 images
- Available for research purposes at:
  `http://www.wavelab.at/sources/PLUSVein-FV3`

Example Images

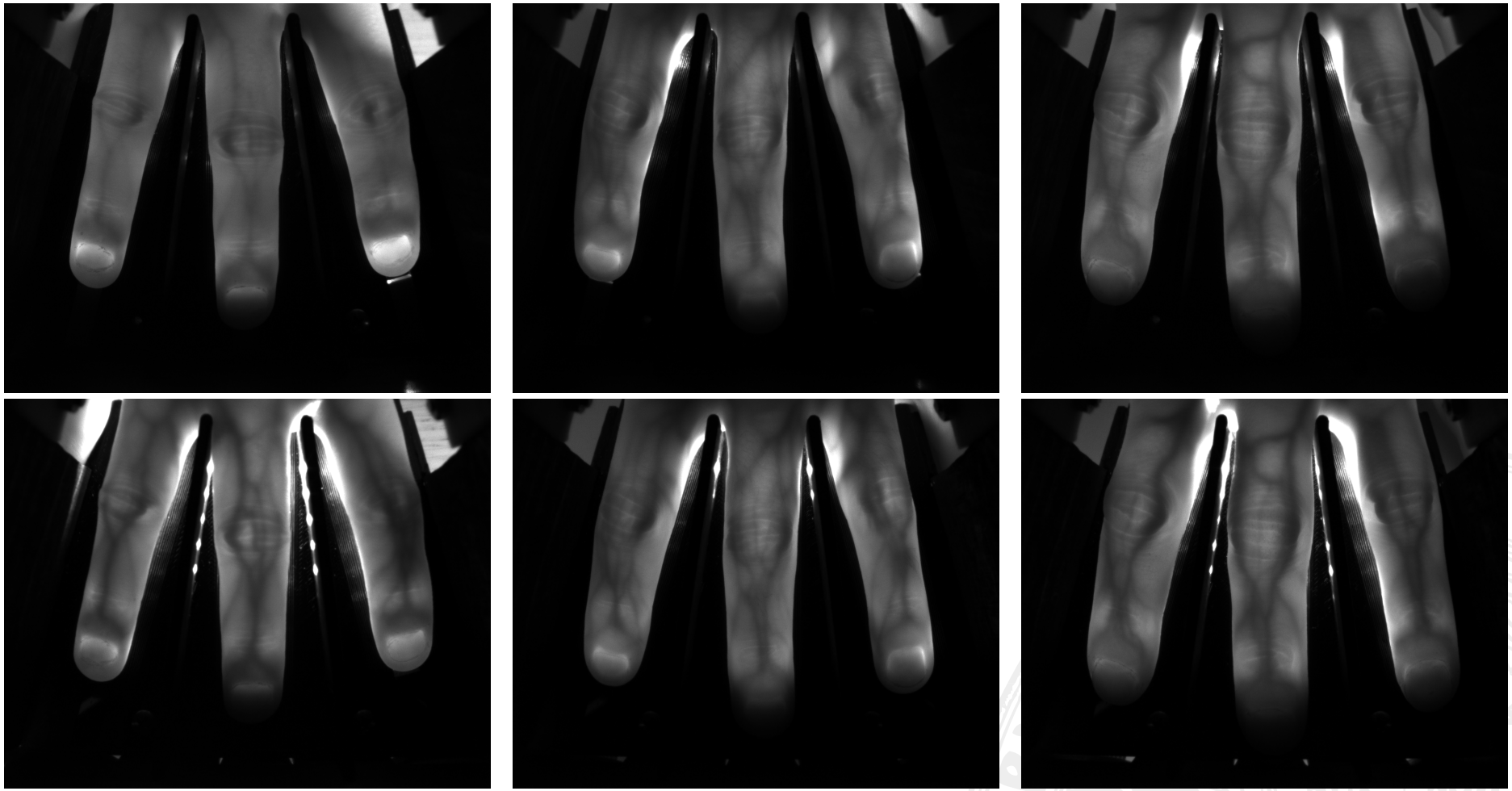


Figure: Data set example images, laser (top) and LED (bottom)

Test Set-Up and Recognition Performance

- ROI extraction, pre-processing (CLAHE [10], HFE [9], CGF [8])
- Tested 4 different schemes: MC [6], PC [1], SIFT [3] and GF [4]
- Followed the test protocol of the FVC2004 [5] to determine EER, FMR1000 and ZeroFMR

		MC	PC	SIFT	GF
laser	EER	**0.028**	0.331	0.111	0.523
	FMR1000	**0.028**	0.444	0.111	0.694
	ZeroFMR	**0.028**	0.694	0.361	1.306
LED	EER	**0.028**	0.028	0.117	0.336
	FMR1000	**0.028**	0.028	0.139	0.444
	ZeroFMR	0.083	**0.056**	0.361	0.917

Table: Baseline performance results (in percentage terms, the best results per illumination type are highlighted **bold**)

Cross-Sensor and Sex Subgroup Specific Results

	MC	PC	SIFT	GF
EER	0.288	2.775	2.86	1.353
FMR1000	0.478	5.078	5.622	3.522
ZeroFMR	1.267	6.522	7.689	8.144

Table: Cross-sensor (LED vs. laser) comparison performance results

		male		female	
		MC	SIFT	MC	SIFT
nr. of subjects		35		25	
laser	EER	0.0	0.038	0.061	0.122
	FMR1000	0.0	0.286	0.067	0.2
	ZeroFMR	0.0	0.429	0.067	0.4
LED	EER	0.089	0.052	0.0	0.211
	FMR1000	0.048	0.048	0.0	0.267
	ZeroFMR	0.95	0.048	0.0	0.533

Table: Sex subgroup specific results

Conclusion and Future Work

- Established a new, publicly available, dorsal and palmar finger vein data set
  - Available for research purposes at: `http://www.wavelab.at/sources/PLUSVein-FV3`
  - Simple finger vein recognition schemes achieve a decent performance on our data set
- Captured with our self-designed modular, multi-purpose finger vein scanner
  - All design details will be made publicly available soon
  - Advantages of laser modules over LEDs in contactless operation

Future Work

Extend the data set (about 100 subjects by the end of 2018)

Open source our finger vein scanner design

Test more recent finger vein recognition schemes

End

Thank you!

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