

Authentication

Prof. Dr. Helene Dörksen

helene.doerksen@th-owl.de

Learned before

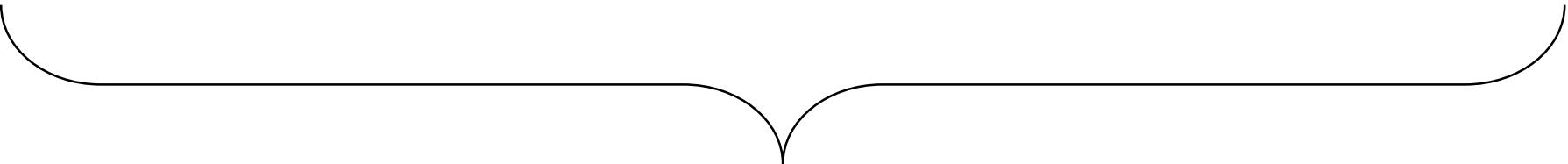
Classification Methods:

- naïve Bayes
- support-vector-machine
- decision tree
- 3-nearest-neighbours
- LDA (good for Gaussian)

Feature Extraction and Feature Selection Methods:

- PCA (good for correlated features; bad for noisy data)
- LDA (good for Gaussian)

... many other methods



Last week:

1. measuring performance of single one method
2. comparing methods

Lecture 8:

**Application:
Banknote Authentication with Mobile Devices¹**

¹ Lohweg, V., Dörksen, H., Hoffmann, J.L., Hildebrand, R., Gillich, E., Schaede, J., Hofmann, J.: Banknote authentication with mobile devices. In: Media Watermarking, Security, and Forensics 2013. (03-07.02.2013) IST/SPIE Electronic Imaging 2013, San Francisco, USA (2013)

ValiCash

in AppStore for iPhones at no charge available



www.t-online.de/digital/handy/id_100009492/valicash-diese-app-erkennt-falschgeld-fuer-sie.html

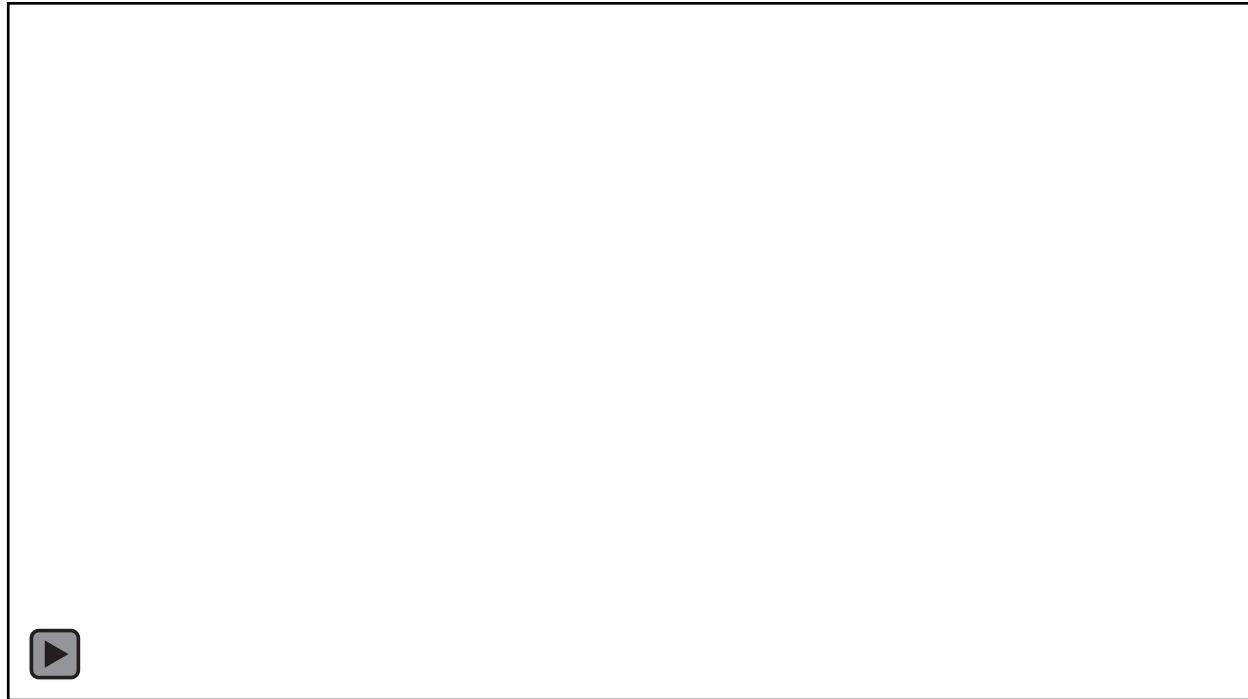
Why do we need banknote authentication?

- Amount of banknotes still rising
- Billions of people trust in banknotes
- Banknote authentication: fundamental in circulation
- Counterfeiters technologies very challenging
 - ✓ Worldwide increase of counterfeits
 - ✓ Forgeries getting better
- Confidence in banknotes must not be lost



Source: flickr.com/gerardolazzari (CC BY 2.0)

Video



Outline

- Introduction to **SOI** (Sound-of-Intaglio) for Security Print Authentication
- SOI Authentication: Primary Model
- SOI Authentication: Extended Model
- Results

Introduction to SOI (Sound-of-Intaglio) for Security Print Authentication

- Optical Banknote Authentication within industrial devices → extension to mobile devices?
- Focus on Intaglio:
Intaglio is tactile, visible, well-established
(in about ~98% of banknotes worldwide)



Introduction to SOI (Sound-of-Intaglio) for Security Print Authentication

KBA Notasys „genuine“ and „forgery“ specimens:



Genuine: banknote-like

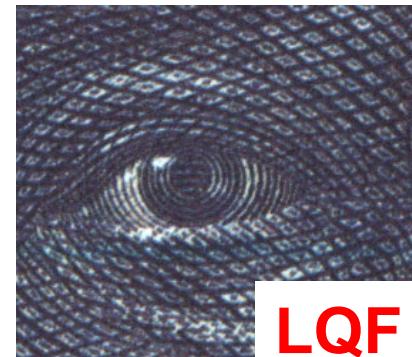
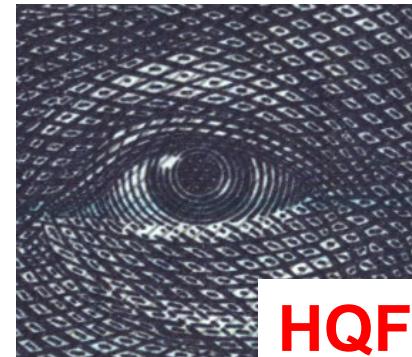
High-Quality Forgery: offset-forgery with genuine paper and original image data

Low-Quality Forgery: offset-forgery with genuine paper and scanned image data



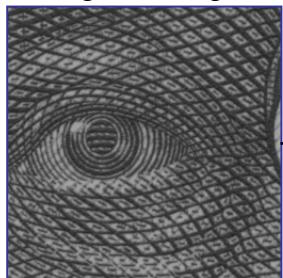
Introduction to SOI (Sound-of-Intaglio) for Security Print Authentication

- Three types of banknotes
 - GEN, HQF, LQF
- Learning and Test methodology:
 - Random selection 300 pcs. for algorithm learning
 - Test phase: 900 banknotes, 300 of each type
 - Additionally: 9 strongly crumpled, 15 soiled banknotes
 - **Unknowns: 3897 pcs.**



Introduction to SOI (Sound-of-Intaglio) for Security Print Authentication

original image

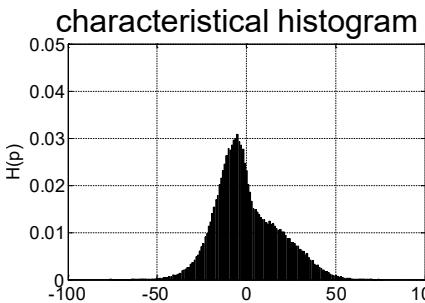
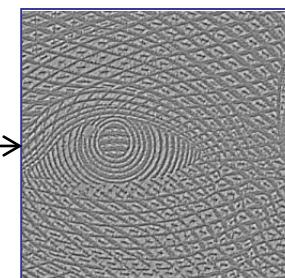


GEN, HQF, LFQ

I. Image Pre-Processing

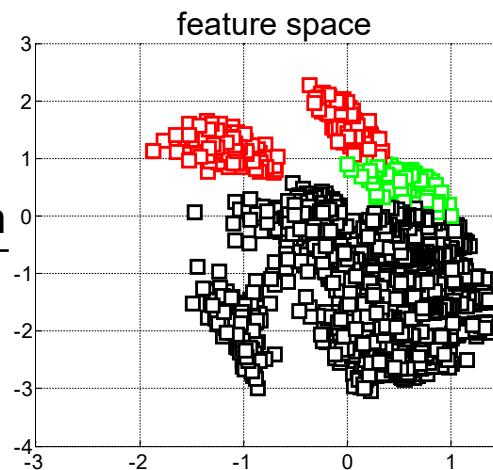
II. Feature Generation

transformed image



genuine?
what kind of forgery?

III. Classification



SOI Authentication: Primary Model

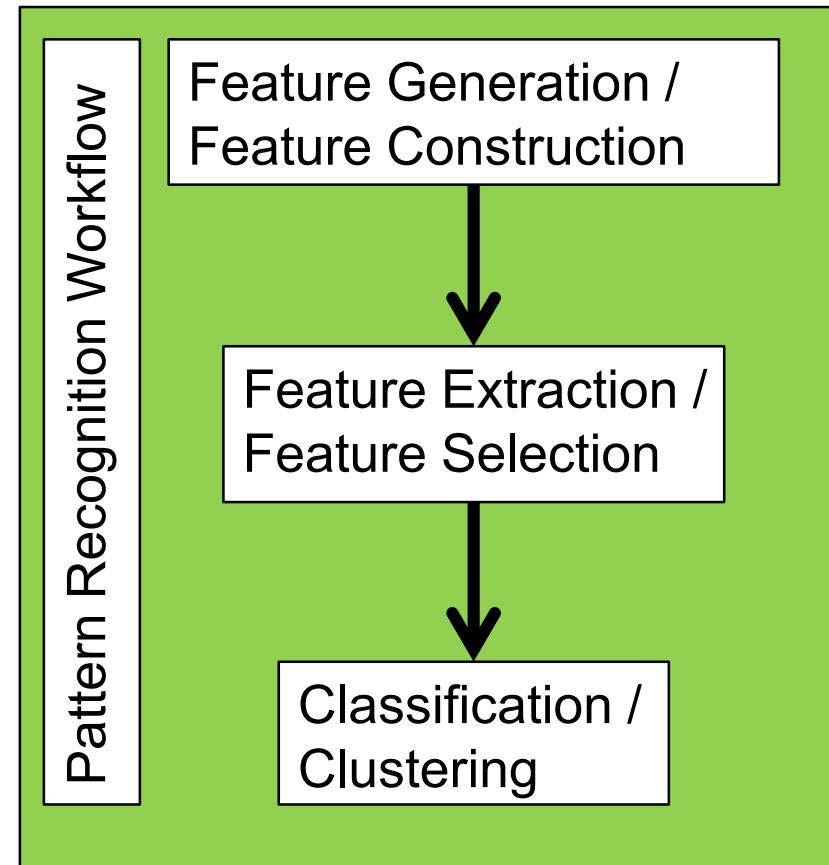
According to THOMSON REUTERS

Science Citation Index

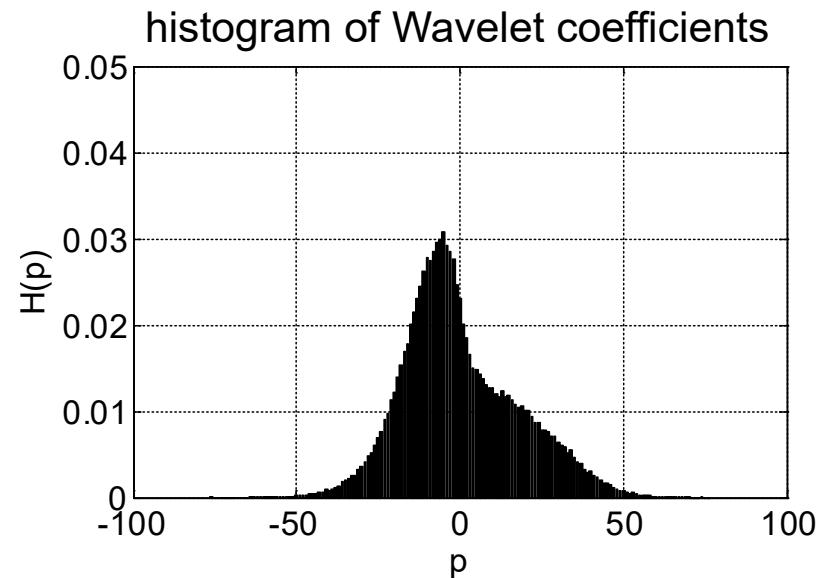
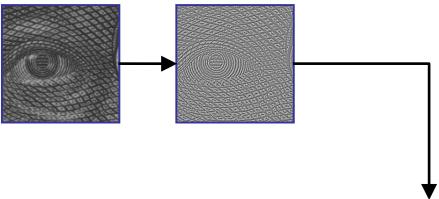
(<https://webofknowledge.com>)

known for, e.g., *Impact Factor*

- “feature generation” or “ feature construction”
1,223 papers **0.48%**
- “feature extraction” or “feature selection”
7,759 papers **3.03%**
- “classification” or “clustering”
247,099 papers **96.49%**



SOI Authentication: Primary Model

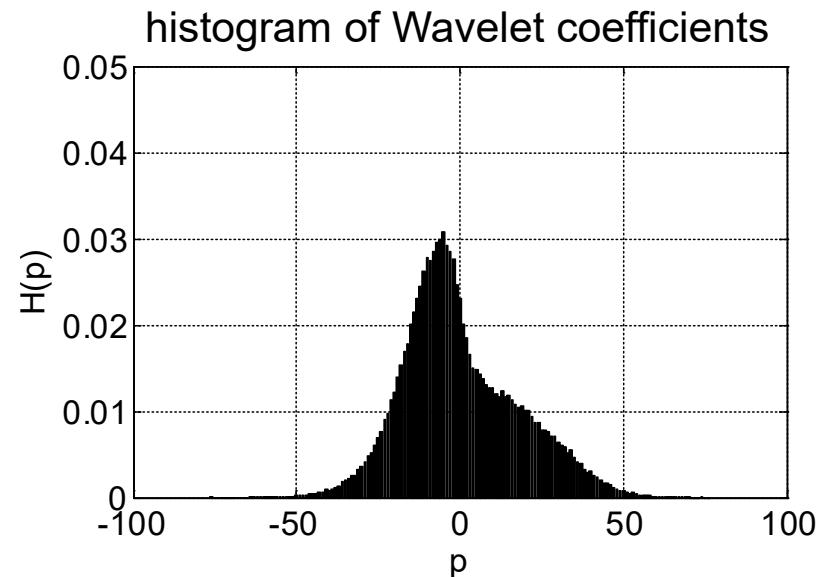


Feature Generation:

In general (application independent):

- features that are individually not relevant might be relevant if combined with others
- features that are individually relevant might be less useful if combined with others
- appropriate **relevance metric (e.g. FDR)** for feature ranking has to be chosen

SOI Authentication: Primary Model



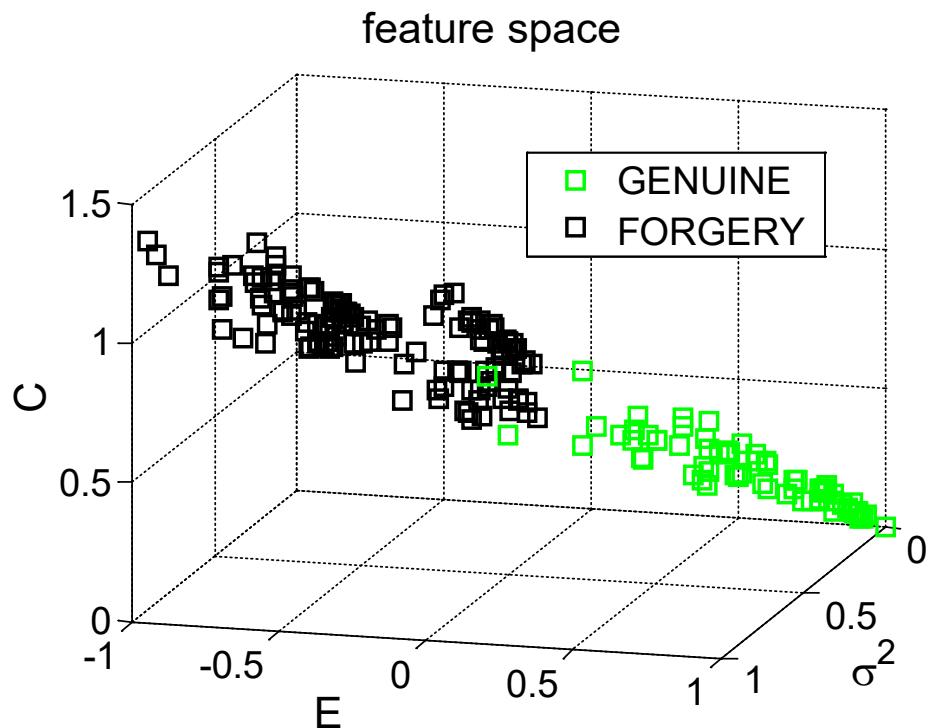
Feature Generation:

statistical moments

- variance σ^2 (measure of how far spread out)
- skewness E (measure of asymmetry)
- kurtosis C (measure of „peakedness“)

are **shape characteristics** of histogram

SOI Authentication: Primary Model



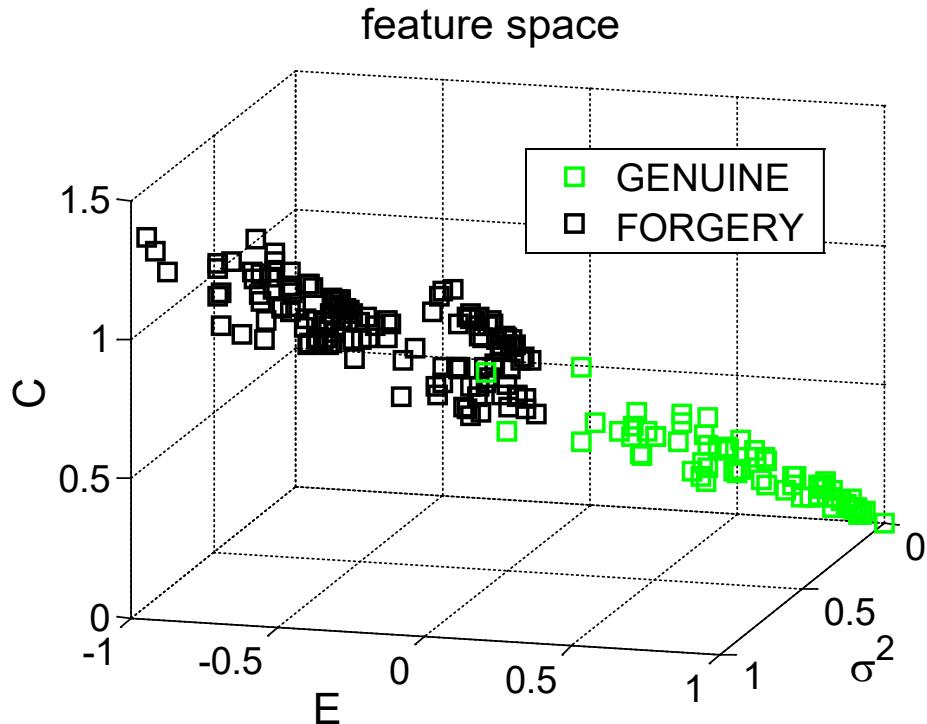
Classification:

In general:

- several linear or kernel classifiers can be used, most likely their classification rates will differ only insignificant
- classification rates might be untrustable since not all possible forgery types are available

SOI Authentication: Primary Model

Classification:

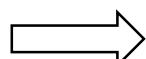


- **linear** approach is mathematically attractive
 - features are Gaussian
- Fisher's Linear Discriminant Analysis
- scientifically well-established
 - relevance metric = **Rayleight coefficient**

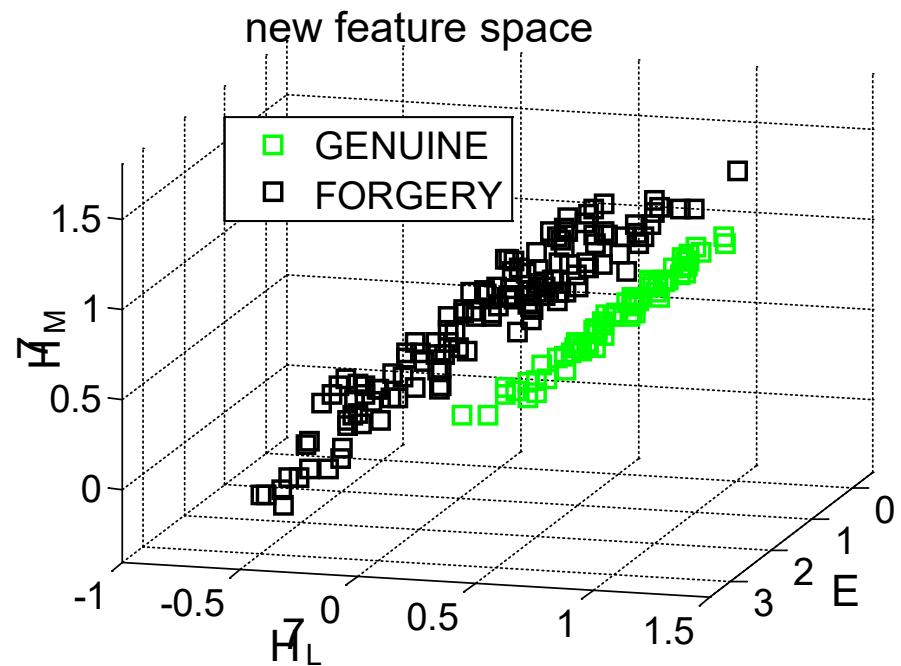
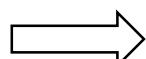
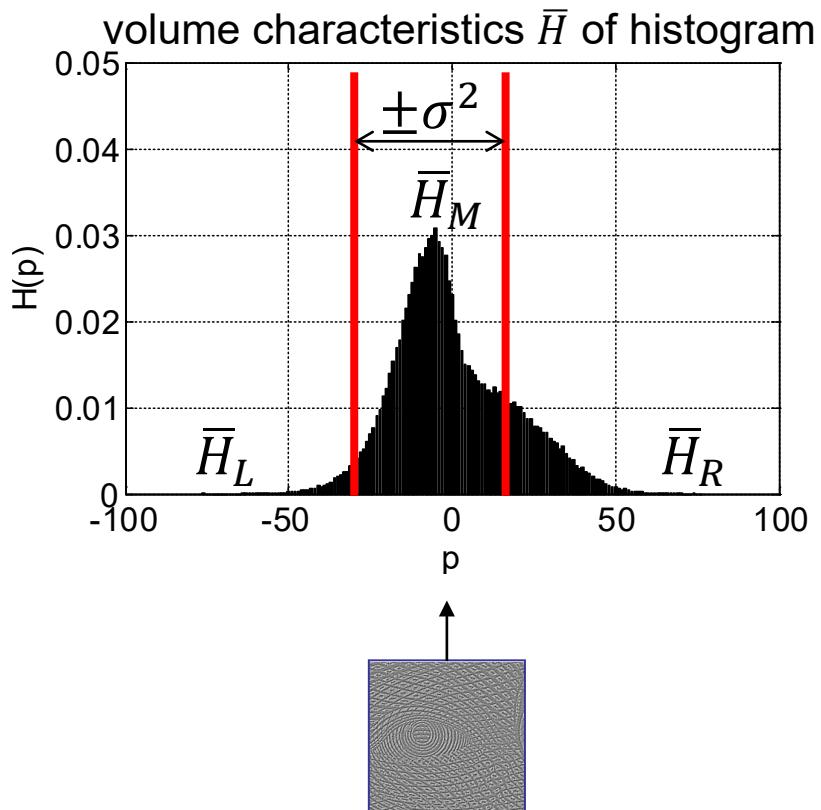
SOI Authentication: Extended Model

New Feature Generation:

- suitable for Intaglio recognition
- complementary to old features
- suitable to primary classification model



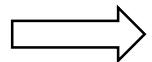
volume characteristics \bar{H} of histogram



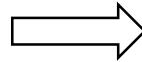
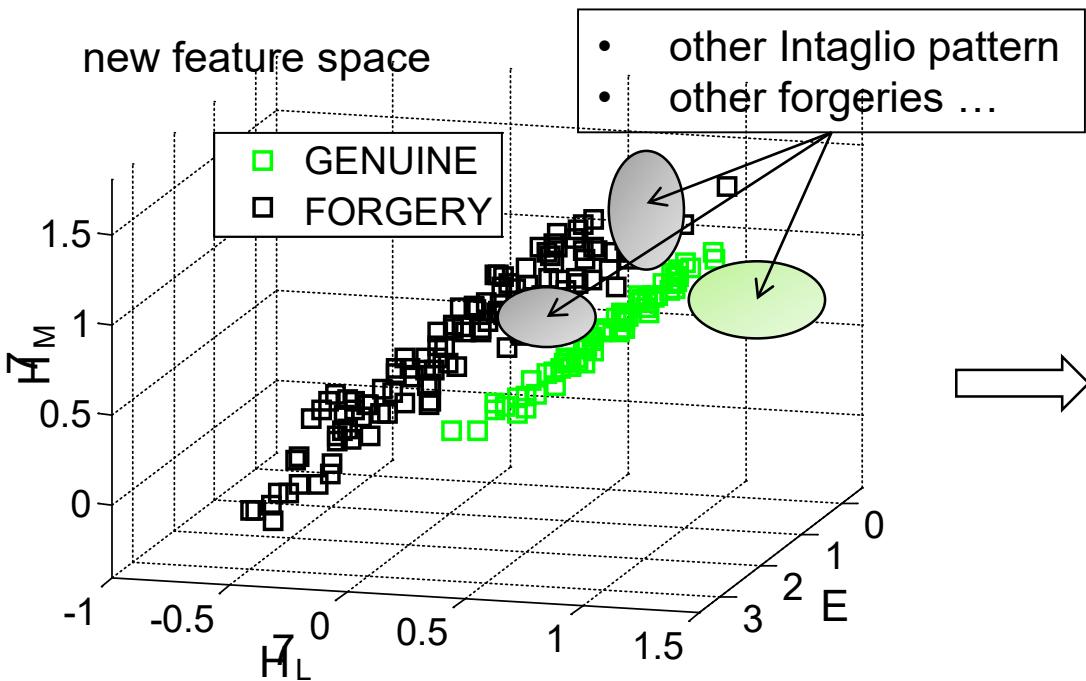
SOI Authentication: Extended Model

Tuning of Classification Model:

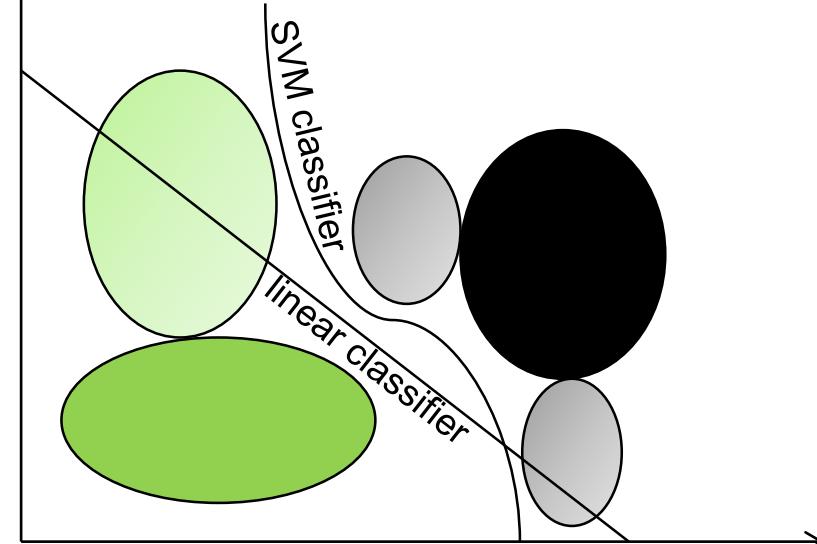
- false classified objects are crucial for our application
- not all possible forgery types are available



tuning with SVM (best case: linear)



SVM tuning on projected linear solution



Primary Results

Classes / detected as	Genuine [%]	NiO [%]	Counterfeit [%]
Genuine	80.3	19.7	0
High-Quality Forgery	0	2.5	97.5
Low-Quality Forgery	0	4.1	95.9



Results of Extensions

Classes / detected as	Genuine [%]	NiO [%]	Counterfeit [%]
Genuine	95.7	4.3	0
High-Quality Forgery	0	2.5	97.5
Low-Quality Forgery	0	4.1	95.9



People behind

SOI Team:

Eugen Gillich (now coverno GmbH)

Jan Leif Hoffmann (now coverno GmbH)

Roland Hildebrand (inIT)

Helene Dörksen (inIT)



Prof. Dr.-Ing. Volker Lohweg – SOI Principal Investigator

Johannes Schaede – Technical Director

Jürg Hofmann – Senior Product Manager Business Innovation

KOENIG & BAUER

Summary

- SOI (Sound-of-Intaglio) Technology for Security Print Authentication
- SOI Authentication: Primary Model
- SOI Authentication: Extended Model

Last but not least



<http://www.akademifantasia.org/europe/genuine-fake-watches-in-turkey-funny/>

Homework: Exercises and Labs

for the next week prepare practical exercises and labs from
Exercises Lec 8 (you will find it in the download area)