Authentication using graphical codes: Information-theoretic approaches

PHAN HO Anh Thu

Advisors: Patrick BAS and Wadih SAWAYA
ESTAMPILLE project (ANR)

- Fight against counterfeit goods

- 6 partners: ATT, LATA, LAGIS, GIPSA, LGP2, CERDI

- Print 2D graphical codes (GC) at the native resolution of printer
  - Not expensive
  - Easy to implement

patented by ATT
Principle of the studied system

- Printing and scanning stochastic and irreversible processes
- Copied GC grey scale noisier than original printed GC
- Original codes shared with receiver
Challenges

C1: Estimate accurately 2 types of error
C2: Binary vs. Grey level observation
C3: Tune P&S to optimize authentication
C4: Can error correcting codes help?
C1: Estimating two types of error

- Neyman-Pearson test
  - H0: code is authentic
  - H1: code is fake

- Gaussian approximation is poor

- Large deviation theory to compute accurately $\alpha$ and $\beta$

- Importance sampling practically check accuracy
C2: Binary vs. Grey level observation?

- Binarization
  - Counting error
  - No need to know opponent channel

- Grey level
  - Need to know opponent channel
  - Better performance
C2: Binary vs. Grey level observation?
C3: Optimal channel for authentication

Given $\alpha$, find a channel to minimize $\beta$

- Good legitimate printer $\rightarrow$ good for opponent
- Noisy printer $\rightarrow$ authentic & fake equally noisy
Optimization in practice

- Use a pattern 9 dots (3x3 matrix) instead of a single dot.

There are 512 patents to tune to optimise.

Graphical codes
C4: Can error correcting codes help?
Conclusions

- Give mathematical models to analyze authentication problem using GC.

- Applicable for security problems of physical objects basing on fingerprinting.
The thesis “Information-theoretic and statistical approaches to the problem of authentication using graphical codes” was defended on Dec 18th under the committee

Reporters:
- M. Jean-Claude Belfiore, Prof. at Telecom ParisTech
- M. Sviatoslav Voloshynovsjiy, Prof. at University Genève

Members:
- M. Igor Nikiforov, Prof. at University Technology Troyes
- Mme. Tanya Ignatenko, Dr. at University Tech. of Eindhoven
- M. Yves Delignon, Prof. at Telecom-Lille
- M. Zbigniew Sagan, Engineer at Advanced Track and Trace


A.T Phan Ho, Authentication using graphical codes: statistical analysis, Oral talk at workshop of GdR ISIS, November 2013