„Something, that is allegedly secure
is not necessarily secure,
Something, that is allegedly known
might turn out to be unknown.
Appearance can be deceptive,
our senses can deceive us.
Even though experience and knowledge
can limit errors,
reality also limits those.“

Inspired by Berthold Brecht
Author: unknown
16 members
10 PHD students
+ Master and Bachelor students
P(Security) = 1 - P(Crime)
Is security the absence of crime?

Dirk Labudde and Michael Spranger
Sonntag, 9. Juli 2017
Introduction

Germanwings Flight 9525, March 24, 2015

2017 terrorist attack London

2016 attack on a Swiss train
Motivation – Germanwings Flight 9525, March 24, 2015

- Departure: 10:01 CET
- Cruise Altitude (38,000ft): 10:27 CET
- Pilot leaves Flightdeck for short break
Motivation – Germanwings Flight 9525, March 24, 2015

- Departure: 10:01 CET
- Cruise Altitude: 38,000 ft (10:27 CET)
- Pilot leaves Flightdeck for short break (10:31 CET)
- Co-pilot initiates fatal descent
Motivation – Germanwings Flight 9525, March 24, 2015

- Departure: 10:01 CET
- Cruise Altitude (38,000ft): 10:27 CET
- Pilot leaves Flightdeck for short break: 10:31 CET
- Co-pilot initiates fatal descent: 10:41 CET
- Crash: 10:41 CET
What does security mean in this context?

Security means protection of humans or things from humans.
What does crime mean in this context?

Violating the right of physical and psychological integrity and sacredness of property.
Can we model security by simulating crime?

\[ P(\text{Security}) = 1 - P(\text{Crime}) \]

*Is security the absence of crime?*
Levels of Security

International security interests
- Terror
- Civil war
- Plane hijacking

National security interests
- Extremism
- Amok
- Organized crime

Regional security interests
- Burglary series

Personal security interests
- Burglary
Aspects of Security

- Technical security
- Legal security
- Perceived security

A. Actors
- Residents, neighbors

B. Urban Structure

C. Law and Order
- Right to physical integrity
- Inviolability of the home
- Data protection

Image: Police officers are your friends. They want to help you.
Approaches
Top-Down - Approach

Approaches for security from the system theory
Methods in information gathering

Top-down (deductive)

- Creating experimental data
- Analysis of data and formulation of hypotheses (iterative)
- Validate hypotheses by means of experiments (iterative)
- **Goal:** Identification and characterization of new mechanisms leading to a better understanding of the complex relations in a “populated urban structure”
- Integration in the resilience process

Measurement of overall condition

Data analysis and integration

Network analysis

Modeling
A **Simulation** is an approach used for the **analysis** of systems which are too complex to be analyzed theoretically or with formulas. This is mostly the case for **dynamic system behavior**. In a simulation, experiments are performed with a model in order to gain knowledge about the real system.

- Discovering of network structures on different levels
- Gathering of the temporal and spatial dynamic of „cellular/system“ components using different (environmental) conditions
- Development of detailed mathematical models
- Visualization of networks and the processes taking place within those networks
  -> Understanding of the processes as a whole
Cellular automata and multi-agent systems can be used for the simulation of the dynamic of **spatial processes**.
Cellular automata model spatial elements such as streets, parcels of land, and buildings. Those are treated as locally fixed objects, whose state can change at a certain point in time. In a first step, these elements are transferred to a cell of a regular grid and saved as the status of this cell.
A second level includes the individual and collective urban actors, which will be called agents. In comparison to the cells, agents are mobile and can move freely through the cell grid, the cellular room. It is possible to define different types of communication between the agents and between the agents and the cell.
FACS (Free Agents in a Cellular Space)

Model of an urban system. The system is separated in different levels, which are represented either by the cells of a CA or the agents of the MAS.
Ideas for Implementation

\[ P(\text{Security}) = 1 - P(\text{crime}) \]
Cellular Automata

- Interaction with neighboring cells in a fixed grid
- Neighborly relations have to be determined at the beginning

Graph Automata

- Neighbor geometry can be flexibly modified
- Neighborly relations can change at any time

Definition of neighbors by means of a graph
Near-repeat pattern analysis

Question:
When a criminal event takes place, how does the risk develop in the surrounding area?

→ Repeated attacks at the same or nearby places

\[ P(A|x, t) \rightarrow P(B|x + \Delta x, t + \Delta t) \]

What influence does an assault A at the place x at the time t have at a later point in time t + \Delta t and a nearby place x + \Delta x.

Relations for time and space can be derived from statistics.
First „statistic of criminal activity“ – people mark crimes on a map. Basic idea – divide in quadrants (grid)
BigData – Predictive Policing

Number of criminal offences and their „circumstances“
Near-repeat pattern analysis

Cyclic-load forecasting

Question:
Are there certain days in the year, certain days of the week or certain times in the day in which more criminal incidents are to be expected?

\[
P(\text{Event}|\text{Point in time}) = P(\text{Event}|\text{Month})
+ P(\text{Event}|\text{Day}) + P(\text{Event}|\text{Day of the week})
+ P(\text{Event}|\text{Time of day}) + ...
\]
Result

B \((x+\Delta, y+\Delta)\)

A \((x, y)\)

r
Graphen Automaten
Securit of a house in an urban structure with a well defined crime rate
Simulation Grid
Simulation Urban Structure
Modelling patterns of burglary on street networks

Primal Representation Modell [Porta et al. 2006]

- Graph $G=(V,E)$
- Intersections of streets are nodes $V$
- Enclosed segments of streets are the edges $E$

Betweenness Centrality
Modelling patterns of burglary on streetnetworks

The risk of a burglary happening at a certain point in time on a specific stretch of road shall be determined -> the risk passes from segments with a high risk to segments with a lower risk

\[ R_i(t) = S_i + Q_i(t) \]

risk -> static and dynamic components

\[ S_i = (D_i + W_i)p_i, \]

\[ W_i = f(C_i). \]

\[ p_i = 1 - e^{-B_i \delta t}. \]

D_i constant for activities, which cannot be explicitly captured

Activity of pedestrians (in a wider sense) is a function of betweenness centrality (function-> non-linear behavior)

Probability of a criminal offence -> probability within a given period of time, determined by the means of the initial attractiveness including a number of decisions by the offender

Breakdown

\[ \frac{dQ_i}{dt} = \Gamma R_i - \omega Q_i + \eta \sum_j a_{ij}'(Q_j - Q_i) \]

Growth of crime diffusion from link to link
Modelling patterns of burglary on street networks

Diffusion of the risk

Balance at proportional statistical risk to $C^B$

Risk is artificially suppressed

Street is taken out

Diffusion in different stretches of roads as an answer to burglaries
Results and future work

- Mathematical network model for the simulation of the spread of crime
- Non-linear effects show the significance -> targeted Policing
- Requirement is the presence of relations between network characteristics and crime rates
- Even though an empiric basis was developed, there have been no analyses with the presented metrics
- Next steps:
  - Creating a model showing the consequences of the predictions made for the organization of police operations
  - Statistical analyses
  - Influence of the network configuration on the phenomenon of the near-repeat victimization
  - Implementation in practical police work
This is what defines us.... Our Identity

Real World  

Cyber World

Separation?
Number of annual cyber attacks in the years 2009 to 2014 (in millions)
2013: using a hacked account of the US news agency AP, hacker spread the news that of an explosion in the White House → within minutes the Dow Jones looses about 1%

2012: within 45 minutes the publically traded company Knight Capital losses US$ 440 Million because of a flawed computer software (Malware) → Shares loose 75 % of their value
Communication and content have changed due to the digitalization.

Digital identity and real identity
Modern communication and crime

Modern ways of communication is not only used in order to perform criminal acts, yet especially to plan criminal activities.

Consideration of digital communication for the modeling and simulation of criminal offences.
Prediction of criminal offences (tendencies), which are planned in virtuality and executed in reality ...

\[ P(\text{security}) = 1 - P(\text{crime}) \]
Crime scene hypotheses cycle
Human Individual Digital Footprint (HIDF) Network

- Communication
- Information transfer
- Feelings
- Emotions
- Sentiments
- Statements

- Analyses
- Validation
- Evaluation

HIDF in groups, sub-groups
Human Individual Digital Footprint (HIDF) Network
An ontology is a specification of a conceptualization.

Definition of syntax of terms and symbols in a network of associations.
Summary of the Study:
- 86,000 participants
- Facebook-Account
- Analyze the Likes
- personality test 100 questions
- friends and more
- "Big Five" model

Computer-based personality judgments are more accurate than those made by humans

Wu Youyou¹,², Michal Kosinski¹, and David Stillwell³

¹Department of Psychology, University of Cambridge, Cambridge CB2 3EB, United Kingdom; and ³Department of Computer Science, Stanford University, Stanford, CA 94305
Social networks - Sentiment analyses of groups in social networks and
**Sentiment Detection:**
- sub-area of text mining
- automatic analysis of texts with the aim of identifying an *expressed attitude* as positive or negative

**Statistical analysis starts from a basic set of concepts (or n-grams),**
- which is associated positive or negative sentiments.
- Occurrences of positive or negative sentiments
- Comparison
- Designation of trends, opinions Statements

**Inside the Web --- feelings, beliefs and personal opinions!**
Social networks

Generation of person landscapes from Facebook

PEGIDA – Patriotische Europäer gegen die Islamisierung des Abendlandes
(Patriotic Europeans Against the Islamisation of the West)

„Slogan“

- Asylindustrie – asylum industry
- Lügenpresse – lies press
- Volksverräter – public traitor
- Der Untergang des Abendlandes
- „the decline of the West”
- Islamisierung ... Islamic
PEGIDA – Patriotische Europäer gegen die Islamisierung des Abendlandes
(Patriotic Europeans Against the Islamisation of the West)

A political movement

• far-right, conservative, nationalist
• anti-Islam

• formed in **October 2014**
• present in Saxony region of Germany, many offshoots exist(ed) in other German cities and countries

Causes for the group’s sudden uprising and gain in popularity:
• Nationalist anti-EU movements had grown to significant sizes in entire Europe in 2014
• refugee crisis
• Acts of Islamist terrorism and violence in Europe
  → Increase of Islamophobia
Generation of landscapes from Facebook
Social networks

Generation of person landscapes from Facebook

Information exchange via FB

Graph API
application
programming
interface
Generation of landscapes from Facebook

Comments

Marika Heimer Hallo Merkel..tschüss bitte....Sie sind der Gefolgsmann der Industrie und ein Verräter
See Translation
Like · Reply · 3 · 3 hrs · Edited

Kerstin Muschke Diese Frau hat jeglichen Bezug zur Realität verloren, ich frage mich, WER oder WAS sie noch stoppen kann ... See Translation
Definition of a general **Data Model** – based on the Graph API

Information from FB via API → Data model

“all” relevant Data (Subsets)

Search relations and correlations

and sentence
**Social networks**

![Graphical view of social network analysis](image)

**Outline**

ID: 780608100971510, 1038273228322508
Caption: episotimes.de
Message:

PEGIDA #Informerstich #InformerStolz
Ja, vom sogenannten "arabischen Frühling" kennen wir das alle.

In Skandinavien kennt man es schon länger als "Vergewaltigungsphäno-
m".

Das BKA kennt aus einigen arabischen Ländern das Phänomen der gemeinschaftlich begangenen sexuellen Belästigung von Frauen durch junge Männer in der Öffentlichkeit. Dies gelte bis zur Vergewaltigungen. Ein vergleichbares Phänomen sei in Deutschland bislang nicht bekannt.

**CONFERENCE-PAPER**

*Towards Predictive Policing: Knowledge-based Monitoring of Social Networks*

**Autoren:**
Michael Spranger, Florian Heinke, Steffen Grunert, Dirk Labudde

**veröffentlicht:**
IMMI2015
Generierung von Wissenslandkarten aus Facebook
Participants FB_ID → user profiles

- User activities
- Topics
- Subgroups
- User-specific content
- Sentiments of the network
All information are labeled by time and user!

Analyze der opinion in der Group
a. positive
b. negative
c. neutral

Sentiment Analyze

Time and geographical Monitoring
Social networks

Opinions and moods (Sentences)

hot phase

- Negative Comment Sentences
- Negative Post Sentences
Digitized traces - geographical Monitoring

Digital traces
Digitized traces - geographical Monitoring

Foto BigData

Video BigData
What makes pictures and videos from the perspective of Forensics so interesting?

- Database forensics
- Mobile device forensics
- Forensic video
- Forensic audio

- Manipulation of pictures
- artificial generation of Pictures
- class of devices (digital camera, scanner, etc.)

<table>
<thead>
<tr>
<th>Content</th>
<th>Meta-data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>
EXIF Metadata (TIFF or JPEG)

Geo-location data

camera- und shooting-related data:
• Aperture
• Time
• Place
• Camera type etc.
Digitized traces - geographical Monitoring

comparison to famous persons

similarity score
digitized traces - geographical monitoring

facial proportions

$$\mathbb{R}^{m \times n} = \begin{pmatrix} r_{1,1} & r_{1,2} & \cdots & r_{1,n} \\ r_{2,1} & r_{2,2} & \cdots & r_{2,n} \\ \vdots & \vdots & \ddots & \vdots \\ r_{m,1} & r_{m,2} & \cdots & r_{m,n} \end{pmatrix}$$

$$r_{i,j} = \frac{a_{i,j}}{a_{i+1,j}}$$

Euclidean distance to the pairwise distances of faces j and k

$$d(j, k) = d(k, j) = \sqrt{(r_{1,j} - r_{1,k})^2 + (r_{2,j} - r_{2,k})^2 + \cdots + (r_{m,j} - r_{m,k})^2}$$

$$= \sqrt{\sum_{i=1}^{m} (r_{i,j} - r_{i,k})^2}.$$
All information are labeled by time, locations and user!

**Sentiment Analyze**

+ **Posible geo-information**
Prediction

BigData – Predictive Policing
Questions

Is it possible to identify threat hot-spots?

Can we predict the long-term development of groups that pose a threat?

Can we support long-term resource and strategy planning?
Number of crimes and their "conditions"
Towards Predictive Policing: Knowledge-based Monitoring of Social Networks

Michael Spranger, Florian Heinke, Steffen Grunert and Dirk Labudde
University of Applied Sciences Mittweida
Mittweida, Germany
Email: {name.surname}@hs-mittweida.de

Abstract—Increasing the resilience of the society against disorders, such as disasters, attacks or threatening groups, is one of the biggest challenges. Recent events highlight the importance of a resilient society and steps which are required to be taken in resilience engineering. A priori the optimal way to handle such adverse events is to prevent them, or at least provide appropriate courses of preparation. The essential requirement for every kind of preparation is information about relevant upcoming events. Such information can be gained for example from social networks and can form the basis for a long-term and short-term strategic planning by security forces. For that purpose, an application framework for knowledge-based monitoring of social networks is proposed, which is able to predict short-term activities as well as the long-term development of potentially dangerous groups, and discuss its basic concepts.

Index Terms—forensic; text processing; resilience engineering
• Extraction of profiles for monitoring
• Extraction of post or comment content relating to the threat ontology and a sentiment analysis
  → enables short-term reaction
• Simulation of temporal development of groups and hot-spots
  → enables long-term resource and strategic planning
• Increasing resilience
Opinions and moods (Sentences)

rights rioters in Leipzig-Connewitz

hot phase

Entsetzen in Leipzig
Rechte Randalierer verwüsten Connewitz

Während in der Leipziger Innenstadt das fremdenfeindliche Legida-Bündnis demonstriert, nutzen rund 250 Hooligans die Gelegenheit, in Connewitz einzufallen. Sie ziehen eine Schneise der Verwüstung durch das linksalternative Viertel, bevor die Polizei die Lage unter Kontrolle bekommt.
• comprised by a set of independent **statistical testing units**
• the role of each unit is to **test the degree of change between sentiment statistics obtained for two points in time**
Sentiment analyses of user comments made on officials PEGIDA’s facebook page → per day ‘temper’ tracking

Boltzmann-stochastic Chi-Squared Tester Network

The networking energy is the sum of all unit energy values → Representation of ‘network awareness’
• an energy value is assigned to each unit

• for each observation (sentiment and comment frequencies), it is decided whether a given unit conducts a statistical test on the new data depending on its energy value

• in the test, the new data is compared to the data the unit processed during the last test! → the network memorizes the data and underlying dynamics!
Sentiment analyses of user comments made on officials PEGIDA’s facebook page → per day ‘temper’ tracking

Are energy peaks correlated to major criminal incidents with anti-Islam and anti-refugee background?

The networking energy is the sum of all unit energy values → Representation of ‘network awareness’
Sentiment analyses of user comments made on officials PEGIDA’s Facebook page → per day ‘temper’ tracking

The networking energy is the sum of all unit energy values → Representation of ‘network awareness’
Are energy peaks correlated to major criminal incidents with anti-Islam and anti-refugee background?

Answer ...... next time
**CONFERENCE-PAPER**

"Semantic Tools for Forensics: Approaches in Forensic Text Analysis"

**Autoren:**
Michael Spranger, Dirk Labudde

**veröffentlicht:**

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**CONFERENCE-PAPER**

"Establishing a Question Answering System for Forensic Texts"

**Autoren:**
Michael Spranger, Dirk Labudde

**veröffentlicht:**
3rd International Conference on Integrated Information, IC-ININFO ISSN: 1977-0428

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**PAPER**


**Autoren:**
Michael Spranger, Stefan Schildbach, Florian Heinke, Steffen Grunert, Dirk Labudde

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"Semantic Tools for Forensics: Towards Finding Evidence in Short Messages"

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Spranger Michael, Dirk Labudde

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The Fourth International Conference on Advances in Information Mining and Management; IMM2014

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**PAPER**

"Towards Establishing an Expert System for Forensic Text Analysis"

**Autoren:**
Spranger Michael, Dirk Labudde

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International Journal On Advances in Intelligent Systems, v 7 n 1&2 2014

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