Using Mobile Phone Data Records to Determine Criminal Activity Space

Presented by:

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Overview

- Activity space
- Proposed new method for examples 1 and 2
- Example 1: Call data records
- Example 2: Active tracking of a suspect
- Example 3: Forensic mapping using call data records
Mental Maps

• **Paths** – routes of travel that tend to dominate most people’s images of cities such as freeways and railways.

• **Edges** – boundaries of lines that help to organise cognitive maps such as rivers, freeways and railways.

• **Districts** – subareas with recognisable unifying characteristics consisting of well established cores with fuzzy boundaries for example business districts or skid rows.

• **Nodes** – intense foci of activities such as intersections, shopping mall, corner shop, etc.

• **Landmarks** – symbols used for orientation but which typically are not physically entered such as high buildings, trees, structures (i.e. water towers), etc.

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**Activity space**

• Proposed new method
• Example 1: Call data records
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Journey-to-Crime

- Crimes in most cases occur close to the offender’s anchor point.
- The number of crimes committed by an offender decreases with distance from his/her anchor point.
- Crime types dictate the distance from the anchor points: violent crime tends to be closer to anchor points than property crimes.
- High crime neighbourhoods influence the crime trip pattern.

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Data from cellular (mobile) telephones

• **Call Data Records**
  • The recorded use by the service provider of the cellular telephone when it receives and makes calls, (including SMS and MMS).

• **Actively tracking the suspect**
  • The cellular telephone is actively tracked at predetermined time intervals such as every five or ten minutes.
## Call Data Records

- **Activity space**
- **Proposed new method**
- Example 1: Call data records
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<th>Time</th>
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<th>No.Calling</th>
<th>Call.Dir</th>
<th>Call Dur</th>
<th>CELL_ID</th>
<th>TOWER_ID</th>
<th>Site location</th>
<th>Site suburb</th>
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</tbody>
</table>
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Cell Network

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Determining the centroid of a cell

Determining the $x,y$ position of a cell used to locate a ping in an active track

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- Offset point to indicate a cell
- Thiessen polygon giving cell coverage
- Begin angle
- End angle
- Azimuth
- MBR created around wedge
- Centroid of MBR giving location of the cell used for linking Cell ID
- Thiessen polygon giving cell coverage
Using Mobile Phone Data Records to Determine Criminal Activity Space

Actively tracking a cellular telephone

- Send a blind SMS to the cellular telephone
- Cellular telephone responds by giving the cell in which it is located
- The cell is then linked to the centroid, which gives the geographic location

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Linking centroids to road network to determine activity space

Use Flowmap to link the interaction to the road network.
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Call data records

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Activity spaces

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Grey area: overlapping activity space
Diurnal patterns

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**Suspect 1 and 2: The ten most used cell towers**

10 most used towers
- **red**: suspect1
- **blue**: suspect2
- **roads**
- **Cape Town suburbs**
- **Ocean**

Map showing the ten most used cell towers for suspects 1 and 2.
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**Frequency of use**

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![Graphs and maps showing frequency of use over time and location](image)
Active tracking

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Land use/cover

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Legend

Cell use COUNT
- 1 - 4
- 5 - 9
- 10 - 16
- 17 - 52
- 53 - 237
- Activity space

Individual1: Land cover of anchor point areas and nodes

- Mercantile
- Mercantile (Motor dealership)
- Mercantile (Shopping mall)
- Education/Health/IT
- Format suburbs
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Diurnal pattern

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First and last pings

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People traveling to and from an event
Activity space as provided by the suspect to the investigating officer

Activity space according to the suspect’s call data records
Using Mobile Phone Data Records to Determine Criminal Activity Space

- Bilateral movement and GPS data
- Truck route
- Communications between the persons
- Cellular base station
- Incident location

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Bilateral movement and GPS: 3D view of communications

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Conclusions

- Using call data records (CDR) and/or active tracking data it is possible to determine the activity space of an individual using cellular telephone data.
- The data alone are not sufficient and need to be supported by local knowledge and gathered intelligence.
- SAPS indicates that it will drastically improve their targeted intelligence gathering based on the analysis done using CDR and/or results from the active tracking of the handset of a suspect.
- The analysis offers the investigating team an effective method to brief a new unacquainted investigating officer who joined the investigation with regards to the suspect’s activity space, anchor points and the suspect’s day/night activity.
Conclusions

• SAPS mentioned that the active tracking of a suspect can help the investigators to establish a finer detail on specific movements than what the CDR can provide.

• They will use the results of the CDR analysis to guide active tracking exercises.

• It is strongly recommended that the above should not be used for prosecution purposes, but only for assisting in solving a criminal case.

• Forensic mapping of call data records can be used for prosecution purposes
Acknowledgements

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