Development of Fast DNA Identification Line (FDIL)

An automated software expert system for DNA-profile analysis, interpretation, comparison and reporting in criminal cases

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FDIL team
DNAxs project team
Division Biological Traces
Division of Digital and Biometrical Traces

November 2021
Police; Faster answers and More capacity

The Trend of Data Creation

Data amount (in Exabytes)

Year

NFI strategy NRTI (Near Real Time Investigation)

Projects:
• Faster answers to the Police (e.g. investigative leads)
• More capacity; more casework and traces
• Reducing costs of DNA profiling

Additional strategies:
• Enhance evidential value;
  - Molecular tools
  - Analytical and statistical tools
• Data mining and success rates
• Intelligence gathering;
  - between different cases, laboratories and countries.
Automation in casework interpretation (DNAxs)

• More markers in DNA-profiling systems (from 10 tot 27 loci)
• DNA-profile comparisons more;
  • complex
  • time-consuming
  • error-prone (without automation)

DNAxs
• DNA-profile comparison and interpretation
• Statistical support integrated
• Creates uniformity
Software suite

CODIS → Bonaparte → SmartRank

LIMS → DNAXs → ClusterXS → DNAStatistX

Son of Grid Engine (SGE)
DNAxs profile comparisons and statistics

➢ Compare autosomal STR profiles.
➢ LoCIM = inference of a major contributor

➢ Estimation of the **Number Of Contributors (NOC)**
DNAStatistX

➢ DNAStatistX for calculating likelihood ratios
➢ Based on EuroForMix (Special thanks to Peter Gill and Øyvind Bleka)
Fast DNA Identification Line (FDIL)
The NRTI strategy

- Automated profile analysis
- Automated databank search
- Automated profile interpretation
- Automated cross contamination check
- Automated reporting to NP/PP

- Control
- Monitoring
Fast DNA Identification Line (NRTI)

• Fast DNA-profiling and matching results.
• Results within three (working) days.
• Investigative leads.
• Based on conventional lab process (including DNA extraction and quantification)
• Workflow for large sample sizes

Pilot (1 nov 2021 till 1 April 2022)
Police district Rotterdam (city)
Public prosecution Rotterdam
Automated profile analysis

Automated cross contamination check

Automated profile interpretation

Automated databank searches

Automated reporting to NP/PP

WorkflowXS

Control and monitoring
HIDAuto → ContaminationXS → DNAxs → SmartRank → CODIS → ReportXS

WorkflowXS:
- References within case
- Elimination database
- Criminal reference database

LabXS
FDIL SmartRank searches

- Compute LR using every person in the DNA database and rank these with the highest on top
- Use top ranked candidates for investigative leads

1. Jan: $\log_{10}(LR) = 9.24$
2. Pete: $\log_{10}(LR) = 5.04$
3. Kees: $\log_{10}(LR) = 4.61$
4. James: $\log_{10}(LR) = 2.79$
5. Henk: $\log_{10}(LR) = 2.18$
SmartRank-LoCIM = phase 1 in FDIL

- Comparison with minimal 9 loci with LoCIM locus type I and II.
- SmartRank LR threshold $10^9$.

- With this strategy only true donors found.
- Success depending:
  1. Complexity of DNA-profile and
  2. Reference profile in DNA databank (SGM+, NGM or PPF6C)
AutoHID → Automatic generation of PDF report

ContaminationXS → WorkflowXS

DNAxs → WorkflowXS

SmartRank → WorkflowXS

CODIS → WorkflowXS

LabXS

ReportXS → Police & public prosecutor
LabXS
Fast ID line > Cross contamination

Worklists

<table>
<thead>
<tr>
<th>Worklist</th>
<th>Date time</th>
<th>#Samples</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAL_SPR-2019-124</td>
<td>8-7-2019 9:17:51</td>
<td>48</td>
<td>Warning</td>
</tr>
<tr>
<td>VAL_SPR-2019-122</td>
<td>8-7-2019 11:07:32</td>
<td>92</td>
<td>Warning</td>
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<td>AABB1111NL#01</td>
<td>Possible contamination</td>
<td>Contaminated</td>
</tr>
<tr>
<td>H6 ABCD1255NL#01</td>
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### Source: AABC1234NL#01

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<th>Extraction</th>
<th>PCR</th>
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### Target: AABB1111NL#01

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**Remarks:**

**Conclusion:** Contaminated

**Remarks:**
Pilot FDIL
Feedback of results to Police/Public Prosecution

- Cut-off samples
- Database search yes/no
- Match result yes/no
  - In case of match person details included
- Initial report through email
- Follow up report (final) through regular route
Pilot FDIL
Compleet process with all partners

- Sampling/safeguarding evidence at crime scene
  - Forensic officers
  - Police

- Sampling, registration and prioritization
  - Forensic and tactical officers
  - Police & Public Prosecution

- DNA Profiling
  - NFI

- Follow up results FDIL
  - Forensic and tactical officers
  - Police & Public Prosecution

Wish to speed up complete process from Intake (currently 2 to 6 weeks)
To Follow up (goal: within 48 hours a follow up plan)
## Technical phases FDIL

<table>
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<th>Phase</th>
<th>Description</th>
<th>Ready</th>
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| 1     | (Deduced) major profile  
       - SmartRank | November 2021 |
| 2     | Both major and minor profile(s)  
       - SmartRank  
       - MixCal  
       - Deconvolution | 2022 |

**FDIL 2022** (Technical phase 2 and Police recovered traces)  
- Possibly 2nd police district  
- Eleven police units
• Forensic Software engineers
• Laboratory Analysts
• Researchers
• Reporting officers
• Team leaders