Evidence-based policing research brief

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Embracing machine learning

Purpose

This brief provides information about ESR and the University of Waikato's work with Artificial Intelligence (AI), in particular machine learning (ML), to support the development of automated workflows in its forensic laboratories while using current infrastructure.

The focus is on streamlining analysis of suspected methamphetamine samples.

What is machine learning?

ML provides computers the ability to automatically learn and improve from experience without being explicitly programmed. It focuses on the development of computer programs that, when exposed to new data, are able to learn, grow, change, identify patterns, develop and make decisions with minimal human interaction.

Background

The use of methamphetamine in New Zealand has remained relatively consistent in the past five years, with 0.8 percent of New Zealanders (31,000 people) using the drug once or more in 2016/17.[i]

In 2014/15, 1,539 offenders were convicted for methamphetamine offences. Of these, 483 (or 31 percent) had previous methamphetamine convictions and 151 (or 10 percent) had been previously charged but not convicted.[ii]

The ability to streamline the analysis of suspected methamphetamine samples will reduce case turn-around times and free up lab resources.

Why is it important?

Currently, the analysis of approximately 80 suspect methamphetamine samples every month makes up a significant proportion of ESR's Drug Chemistry laboratory's work; and while analysis, using FTIR, can be completed relatively quickly, a scientist needs to review and interpret the results.

In addition, in approximately 20 cases per month the presence of impurities or diluents prevents methamphetamine being identified using the current analysis process, and subsequent analysis, typically using Gas Chromatography Mass Spectrometry (GCMS), is needed.

ESR has investigated the suitability of ML for the partial automation of drug analysis to help streamline the throughput of cases – meaning more results in less time.

Why use machine learning?

ML has the potential to streamline the routine and multi-step analysis of samples. The rapid processing provided by the ML application can determine and report the presence of methamphetamine within seconds of sample analysis.

ML also has the potential to identify methamphetamine in complex mixtures. Additionally, streamlining routine methamphetamine analysis and reducing the need for further work will allow drug chemistry analysts to concentrate on more complex cases.

How does machine learning work?

ML works by feeding historical data (observations) through mathematical algorithms that identify patterns. These patterns are expressed as rules and together form a model. The model can then be used to form predictions on new observations.

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Once rules are established and a model is created for the analysis concerned, any user can apply ML to interpret FTIR.

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What does this mean?

ML is able to streamline drug analysis, meaning more results in less time.

A prototype ML application, developed by ESR and the University of Waikato, was capable of generating results from suspected methamphetamine samples in less than a second with an accuracy of 99.8 percent against control data.

The application was also able to predict the purity of methamphetamine in a sample, analyse mixtures and indicate the presence of methamphetamine at low concentrations.

Trialling the application on case work samples for five months showed that significant time savings are possible for this sample type.

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What next?

Work is currently underway at ESR to validate the ML application against a range of methamphetamine samples and non-drug samples for future casework applications. Studies are also being undertaken to use the application to determine the approximate purity of methamphetamine in mixtures.

Future development of the ML application has the potential to create an automated service or even the potential to be applied to self-service kiosks.

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[i] Ministry of Health (2017). *Annual Update of Key Results 2016/17: New Zealand Health Survey*. Ministry of Health, Wellington. Available at https://minhealthnz.shinyapps.io/nz-health-survey-2016-17-annual-data-explorer/_w_2a32f57a/#!/explore-topics (accessed 29 September 2018)

[ii] Department of the Prime Minister and Cabinet (2015) *Tackling Methamphetamine: progress Report* Department of the Prime Minister and Cabinet, Wellington https://dpmc.govt.nz/sites/default/files/2017-03/indicators-and-progress-report-oct2015.pdf

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