

USING EXPERT SYSTEMS FOR CASEWORK ANALYSIS OF DEGRADED AND INHIBITED SINGLE SOURCE SAMPLES

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Expert systems designed for the analysis of single source STR profiles are essential tools in automated DNA data analysis and have been approved for the review of convicted offender samples uploaded directly into the NDIS database. Since many laboratories own an expert system, it is reasonable to consider the tools available with each of the expert systems for the analysis of single source casework samples. Even though mixture deconvolution tools are available for casework, many casework samples for identification of human remains and from homicides, burglaries, and even semen stains from sexual assaults do not contain mixtures. There are no standards approving the use of an expert system for casework analysis; however, an expert system can be used to assist the examiner in review of the data. The analyst must still manually review each casework sample and take ownership of the data prior to reporting a DNA profile from evidence.

Recently, the NIJ Expert System Testbed (NEST) Project Team performed an evaluation of three (3) different expert systems with true casework samples and simulated degraded single source data. Two (2) decomposed bodies were recovered in West Virginia: one in a forest and one in a river. Six (6) samples from each femur were extracted using an organic extraction procedure, the DNA IQ™ System (Promega Corporation, Madison, WI), and the QIAamp DNA Mini Kit (Qiagen, Valencia, CA), each with and without an initial EDTA decalcification step. The samples were then amplified using PowerPlex® 16 System (Promega Corporation). For simulated casework data, 11 single source bloodstain samples with known profiles were irradiated with UV light at varying intervals of 0, 10, 20, 40, 60, 90, and 120 seconds. This method of degradation was designed to simulate naturally occurring degradation caused by sunlight, elevated temperatures, or bacterial contamination. After UV irradiation, the samples were amplified using PowerPlex® 16 System, and AmpFLSTR® Identifier® and Profiler Plus® PCR Amplification Kits (Applied Biosystems, Foster City, CA). Once amplified, all samples were processed through three (3) expert systems: FSS-i3™ Expert System Software v.4.1.3 (Promega Corporation), GeneMapper® ID v.3.2 (Applied Biosystems), and TrueAllele Databank® v.2.9 (Cybergenetics, Pittsburgh, PA) using the same settings optimized for the single source data evaluated for the NEST Project.

The expert system results were assessed based on correct allele calls and the rule firings at each locus. Some results, such as allelic dropout and low peak height, required more human expert intervention, whereas other results only required human verification of a correct call. As expected, using an expert system to evaluate degraded and inhibited casework samples focuses the analyst's attention on rule firings and adds an additional level of review in overall casework allele calling. Using an expert system software package with casework samples can assist the analyst in more efficient review of the data.

This project was supported by Award No. 2007-MU-BX-K008 awarded by the National Institute of Justice, Office of Justice Programs, U.S. Department of Justice. The opinions, findings, and conclusions or recommendations expressed in this presentation are those of the authors and do not necessarily reflect those of the Department of Justice.