B87 The Determination of Key Factors in Particle Combination Analysis to Enable Systematic Improvement, Optimization, and Transition to Practice

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After attending this presentation, attendees will better understand the current state of development of a particle combination analysis capability, results from recent and ongoing research, important next steps for development, opportunities for collaboration, and expected impact — both near and long term.

This presentation will impact the forensic science community by providing the information and perspective necessary to systematically improve particle combination analysis.

Particle combination analysis using Very Small Particles (VSP) is a new approach, highly significant for its potential to expand the number of cases to which trace evidence can meaningfully contribute and for its ability to include a quantitative statistical approach to data interpretation.[1,2] Research has demonstrated this approach has exceptional promise to expand the number of cases in which trace evidence can be used and to provide quantitative measures of evidential value. The laboratory analyses are highly efficient, utilizing existing crime laboratory personnel and equipment.

The current state of development of particle combination analysis will be briefly reviewed: what has been demonstrated, what has been suggested, and what remains to be accomplished. Prior research, employing *reasonable choices* of analytical and statistical parameters, has: (1) demonstrated the presence of highly discriminating VSP profiles on the surfaces of common items of physical evidence; (2) characterized VSP combinations using analytical instrumentation and expertise commonly available in forensic laboratories; (3) developed statistically rigorous measurements of correspondence between VSP profiles; and, (4) produced objective measures for the resulting probative value.[2-4]

The reasonable choices of analytical and statistical parameters employed in prior research were sufficient to demonstrate feasibility and potential. Systematic development and validation of these methods require that the analytical and statistical parameters be more critically examined, and that the key factors influencing the performance of the methods be identified.

The optimization of a VSP analysis protocol requires that factors influencing the reliability, costs, and selectivity be identified. Separating factors (a quantity or quality that does have an influence upon the system) from variables (a quantity or quality that might have an influence upon the system), requires a screening stage of experimental design. The result will be identification of a few important, controlling factors that must be addressed in order to meaningfully optimize the protocol. It will also provide information, such as the variability and magnitude of effects that will be needed for the next stage of process improvement.

Determination of the key factors and the magnitude of their effects will result in a significantly improved capability. Analytical and computational parameters, previously selected as *reasonable choices*, can be revised and replaced, with a combined effect that will have a material impact. Second, these results will provide necessary input to experimental designs that will permit systematic improvement and optimization. Identification of key factors will enable these critical steps and further the transition of particle combination analysis to practice. Third, and most importantly, the results will contribute directly to the fundamental advancement of a new quantitative and broadly applicable approach to trace evidence. Well-documented factors and effects for one VSP analysis protocol will allow parallel, collaborative assessments of alternative options for high efficiency analysis of VSP (such as micro Raman methods, micro X-Ray Fluorescence (microXRF), genetic analysis, or alternative Scanning Electron Microscopy with Energy-Dispersive X-ray Spectroscopy (SEM/EDS) protocols).

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Trace Evidence, Particle Combination Analysis, Very Small Particles

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