Organization: Coventor, Inc.

Title: OptoFlow: Tools for Integrating Optical Detection in µTotal Analysis Systems

MTO **Simbiosys**

Start Date: July 2001 **End Date:** June 2004

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Project Goals

Develop and Demonstrate Application of Design tools that will enable the design of micro-total analysis system (µTAS) containing integrated optical subsystems

Technical Approach

- Develop solver for detailed analysis of coupled optical detection and fluidic transport (OptoFlow)
- (a) Develop tools for modeling the fluidic detection region and couple to optical component modeling tools
- (b) Develop tools for the scalar and rigorous electromagnetic analysis of optical components and systems for the optical detection and illumination of chemical species.
- Develop time domain system simulation capability for integrated optical and fluidic systems
- (a) Optical component library models for mTAS systems (OptoDetLib)
- (b) Fluidic library models for detection region simulation (FlumeLib)
- (c) System Simulator for coupled analysis of optical and fluidic component models
- Build extraction capability to extract reduced order models for detection region from full detailed simulation (OptoFlowMM).
- Verify component level and system level behaviour against experiment. Demonstrate optical subsytems integrated into mTAS devices.

Recent Accomplishments

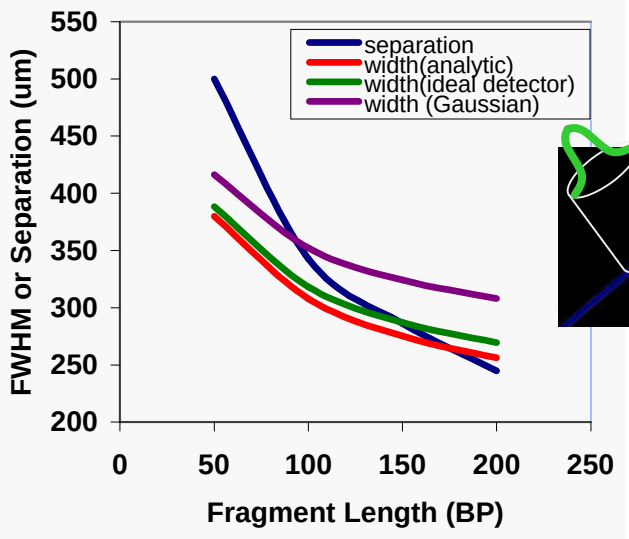
- Detailed Simulation capability for optical components developed using simplistic assumptions about the optical behavior. More complex capability under development.
- Initial components in OptoDetLib and FlumeLib developed. Elements required for a basic microscope model – both chemical and optical are available in the initial element set.
- Experimental program initiated with design and fabrication of generic glass chips. Optical components will be inserted in a layer over this chip for testing.

Six-Month Milestones

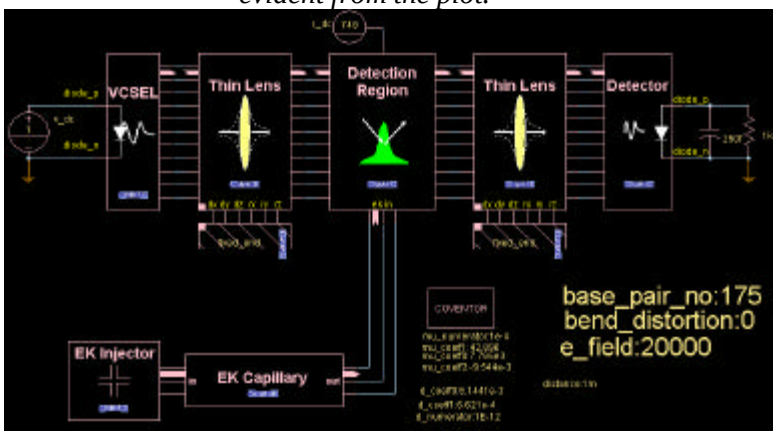
- Initial releases (beta) of the OptoFlow detailed simulation, and OptoDetLib system modeling libraries are planned in the next six months.
- Experimental investigation of a representative integrated optical device breadboard.

Team Member Organizations

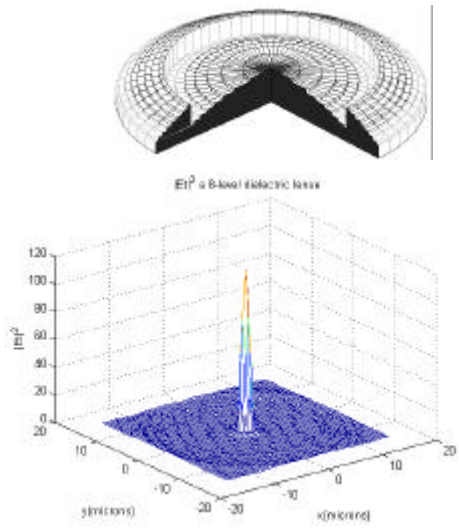
EM Photonics Inc., University of Delaware



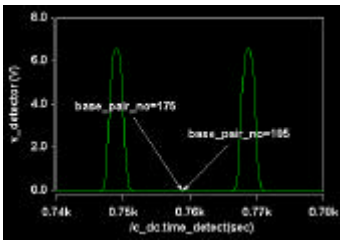
Crossover plot for fragment separation extracted using a finite-width gaussian detector. The loss in resolution from the analytical and ideal detector is evident from the plot.



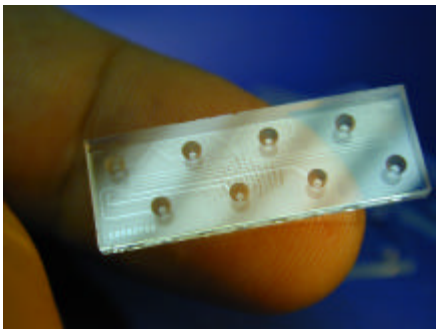
Design Analysis using System model. The graph on the left shows the signal variation due to alignment of the detector. The graph on the right shows signal decay due to incorrect positioning of the light source from the focusing optics.



FDTD analysis showing the design of a dielectric lens.



Basic Microscope model using Fluidic and Optical Elements. Typical results from the system model are shown in the above figure with near field details of the electropherogram.



Experimental Devices fabricated for chemical processing. Optical components will be built on a layer "integrated" on this chip.