Speaker Presentations

Biodetection Sampling Systems

Gary W. Long, Ph.D.
Tetracore, Inc.

Detection and identification of infectious agents is performed on a diverse range of complex materials. The methods used for sample collection and preparation for analyses are varied depending on source, analytic technique and performance goals. Commonly used methods for collection and preparation of forensic, environmental and clinical specimens will be discussed. Some unique difficulties posed by clinical and veterinary specimens will also be described.

Spectroscopy Systems for Biodetection

Luis H. Garcia-Rubio, Ph.D.
College of Marine Science, University of South Florida

Spectrophotometric methods and devices provide both, an alternative and a complement to molecular techniques for the identification and classification of microorganisms and cells. As such, spectrophotometric methods have been used in a variety of ways and configurations to detect specific molecules and to correlate the measured spectral patterns to phenotypical characteristics of microorganisms. This presentation reviews the principles and the state of the art of spectroscopy technologies such as UV/VIS, Light Scattering, Fluorescence, Raman, and MS, for biodetection applications together with novel spectrometer designs aimed at increasing the information content of spectral data. The advantages and limitation of the different techniques are discussed in context of the sensitivity and specificity requirements for the early detection of pathogens and infectious diseases. Successful applications of spectrophometric methods for bioagent detection and for the diagnosis of infectious diseases such as Malaria (parasite infection), Dengue Fever (viral infection), sickle cell anemia (genetic disease) and others are presented and discussed. The considerable implications of spectroscopy technologies, their evolution, and their potential for real-time in-situ monitoring of physiological parameters, telemedicine, epidemics, and other applications are also presented and discussed.

Systems Integration

David W. Cullin, Ph.D.
ICX Technologies, Inc.

Domestic and world events over the past ten years have drastically changed the operational requirements necessary for the nation's biological defense systems. Previously, biological defense was the domain of the Department of Defense (DoD) as they protected troops against largely state threat scenarios. With the increase of terrorist and insurgent threats, we have seen a convergence of needs, from bio-defense systems, for the DoD and in protection of the homeland.

This discussion will focus on the evolution of bio-defense systems over the past fifteen years. The talk will begin with an examination of how the threat has changed and how existing systems have evolved in response to the new threat. This will lead to a discussion of the various component systems which make up the overall bio-defense architecture. Each component system will be described along with a discussion of how those technologies have matured over the past several years. Finally, a series of ideas about future technology and system requirements will be discussed. These concepts will be geared toward providing effective and sustainable systems in the future.

DNA Technologies for Biodetection

Stephen M. Apatow
Humanitarian Resource Institute

An accurate comprehension of the microbial threats presenting a challenge to the U.S. and international community is fundamental to diagnostic competency and the integrated role of the medical and veterinary professions in biodefense. The lack of validated, field tested molecular detection technologies is now the reference point for risk management discussions associated with emerging infectious diseases, bioterrorism, national and international security. The potential for severe outbreaks of high consequence pathogens, the impact on public health and disruptions to international commerce, underscore the importance of these technologies for surveillance, containment and control. The current threat demands a thorough review of available technologies, targeted research and development to address the immediate needs as well as future optimization of the global public health infrastructure.

Screening Phage-displayed Combinatorial Peptide Libraries for Diagnostic Probes and Inhibitors

Brian Kay, Ph.D.
University of Illinois at Chicago

Through various display technologies, such as phage-display, it is possible to generate combinatorial peptide libraries containing billions of potential ligands for a given protein. Through affinity selection experiments, one can isolate phage that bind selectively and tightly to target proteins in a few week's time. Interestingly, the selected peptide ligands often bind the target at sites of protein-protein interaction or within catalytic pockets; consequently, such peptides can be formatted in assays for detecting the target, as well as used *in vitro* or *in vivo* as inhibitors. Several examples of this technology will be described for the detection and treatment of pathogens, including the use of peptide ligands to block anthrax toxin and its host receptor, *Plasmodium* invasion, and for the species-specific detection of *Bacillus* spores.

Cellular Principles of Signaling: Living Cells as Biosensors

Dr. Larry A. Sklar
University of New Mexico

Cells and cell networks function as exquisitely sensitive detectors, responding to single photons, piconewton forces, and single digit numbers of molecular recognition events. These processes are made possible through a number of principles that include: amplification and differential amplification and differential stoichiometry of signaling components; redundant extracellular recognition pathways that may include arrays of molecular recognition, antennae, and sequential signal processing steps which amplify or enhance the display or presentation of input signal from one cell type to another; redundant intracellular pathways or networks that compensate for the failures of individual pathways; compartmentalization of intracellular processes which may accumulate or localize signaling elements; heterogeneity of signaling media which include two dimensional arrays, diffusion in two and three dimensions, and compartments which are specialized to communicate between the media; desensitization processes which may adjust gain and terminate or recycle signaling elements for reuse in another location or another time; and dampening processes by which interacting pathways may cancel one another out. Biological systems may function in autocrine, endocrine, and juxtacrine modes, i.e. through self regulation, through production of mediators that act on distance cells, and through nearest neighbor regulation. Cells, as sensors, do not exist in a static format. They may multiply (proliferate), change their form (differentiate), die as a response to environmental toxicity, or program their own death (apoptosis), presumably to prevent the proliferation of an injurious phenotype. As appropriate, specific examples will be drawn from paradigms of acute host defense involving the interactions between neutrophils and bacteria.