M9, ICB, Systems Technology

**(Dr. Seongkyu Yoon, UML, Dr. Prokash Paul, UML)**

Systems engineering provides convenient and useful tools for analyzing improving continuous processes. These tools can be very well utilized for improving productivity and product quality consistency. However, since current biopharmaceutical processes are based on batch operations, these benefits have not been fully exercised in the industry. By introducing the continuous paradigm in biopharmaceutical industry, these tools can be implemented for continuous bioprocesses. This module is designed to introduce the basic concepts and potential applications of the systems engineering technologies.

In this module, participants will learn about:

Advanced control algorithm – feedforward, cascase, and predictor

Multiloop and Multivariable control

Model Predictive Control Process

Optimization Planning and Scheduling

Experimental Design

Multivariate Data Analysis – Summary,

Regression and Classification



Dr. Prokash Paul is a post-doctoral researcher in the Massachusetts BioManufacturing Center (MBMC) at University of Massachusetts, Lowell. Dr. Paul’s research area is System Biology. Research covers pharmaceutical modeling, simulation, parameter estimation and optimization and statistical analysis. Research aims at developing innovative systems technology to improve drug development efficiency, manufacturing productivity for selected diseases. He is currently developing methodologies for evaluating bioequivalence between original and generic drugs. He is recognized as session developer for the Annual ISA POWID Symposium and co-chair of career development forum.

Dr. Paul completed his Ph. D in Chemical Engineering from West Virginia University (West Virginia, USA) under the supervision of Dr. Debangsu Bhattacharyya, Dr. Richard Turton and Dr. Stephen Zitney. He is specialized in process system engineering. He provided consulting on process modeling, pattern recognition, fault detection and identification in Expert Microsystems Inc. During his Ph.D., he worked on state estimation, measurement and process noise variance-covariance, process control and monitoring. He developed sensor network design algorithm for industrial scale power plants for maximizing efficiency with improved control performance. He was an active member of the Advanced Virtual Energy Simulation Training and Research (AVESTAR®) Center, a sister facility at West Virginia University.



Dr. Seongkyu Yoon is director of the Massachusetts BioManufacturing Center (MBMC), process system engineering and an assosiate professor in the department of Chemical Engineering of the University of Massachusetts Lowell. His research area is Life Sciences Systems Engineering. Research covers Process Analytical Technology (PAT) and Quality by Design (QbD), Application of Design of Experiment (DoE) and MultiVariate Data Analysis (MVDA), supply chain management in biologics, and chemometrics in life sciences. Research aims at developing innovative systems technology with which one can improve drug development efficiency and manufacturing productivity, and developing innovative diagnostic systems and tools for selected diseases with chemometrics framework. He is currently developing system tools using a genomics and metabolic flux analysis approach to explain variability to productivity and quality of CHO (Chinese Hamster Ovary) mammalian cell-culture product.  Integration of medical devices with multivariate statistical method is also being explored to develop practical diagnostic tools. Dr. Yoon completed his Ph. D. in Chemical Engineering from McMaster University (Hamilton, Canada). Afterwards, he worked at Umetrics (Kinnelon, NJ). He provided consulting and teaching on multivariate data analysis, experimental design, and batch analysis in various industries, pharmaceutical, biologics, semi-conductor, petrochemical, and financial. Before joining UMass Lowell, Dr. Yoon worked at Biogen Biopharmaceutical Inc. as process analytics group leader of manufacturing sciences. He implemented MSPC (Multivariate Statistical Process Control) to all unit operations of both commercial and clinical manufacturing. He also worked at Hyundai Petrochemical (now LG Chemistry) as a process engineer and implemented Advanced Process Control and Real-time Optimizer to ethylene manufacturing process in early 1990.