Intelligent Control of Bioprocesses

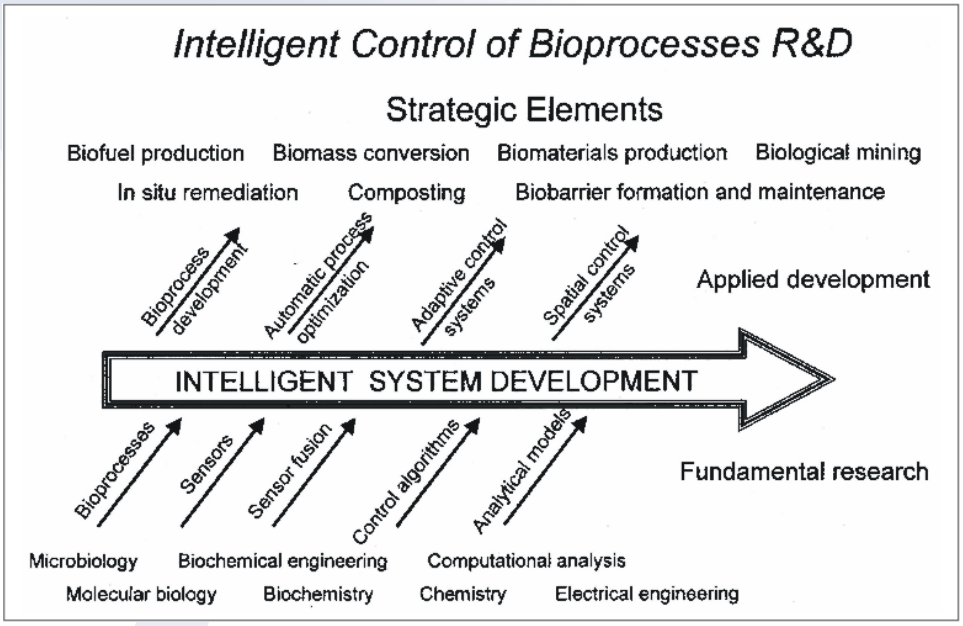
Artificial intelligence has the potential to incorporate human experience and reasoning into a computer. By emulating human thought processes and incorporating an extensive database in each control decision, artificial intelligence can radically alter the approach to bioprocess control and microbiological research.

The advantages of learning-based control systems are that they:

- Learn as they operate
- Do not require previous knowledge or models
- Can determine coupled or interactive parameters
- Characterize functions
- Determine coupled or interactive metabolic processes independently of growth.

Continued on next page





Science
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Continued from front

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INL is a U.S. Department of Energy national laboratory operated by Battelle Energy Alliance

Progress

INL has developed learning-based intelligent control technologies for microbiological systems such as:

- Iron oxidation by a mesophilic bacterial culture, *Thiobacillus ferrooxidans*
- Iron oxidation by a mixed culture of mesophilic and thermophilic bacteria
- Cultivation of *Methylosinus trichosporium* with the bubbleless addition of methane and air.

Selected Publications/ Presentations

D.L. Stoner, A.P. Poloski, J.A. Johnson, and C.R. Tolle, "Optimization and Control of Dynamic Bioprocesses," *Organic Process Research & Development*, Vol. 5, No. 3, 2001, pp. 299–307.

D.L. Stoner, K.S. Miller, D.J. Fife, E.D. Larsen, C.R. Tolle, and J.A. Johnson, "Use of an Intelligent Control System to Evaluate Multiparametric Effects on Iron Oxidation by Thermophilic Bacteria," *Applied and Environmental Microbiology*, Vol. 64, 1998, pp. 4555-4565.

D.L. Stoner and C.R. Tolle, "Issues Involved with the Non-Characterized Control of Methanotrophic Bacteria," *Proceedings of the 16th Symposium on Energy Engineering Sciences. May 13–14, 1998, Argonne National Laboratory, Argonne, Illinois*, pp. 162–169, 1998.



D.L. Stoner, C.A. Browning, D.K. Bulmer, T.E. Ward, and M.T. MacDonell, "Direct 5S rRNA Assay for Monitoring Mixed-Culture Bioprocesses," *Applied and Environmental Microbiology*, Vol. 62, 1996, pp. 1969–1976.

J.A. Johnson and H.B. Smartt, "Advantages of an Alternative Form of Fuzzy Logic," IEEE Transactions on Fuzzy Logic, Vol. 3, 1995, pp. 149–157.