Fachhochschule Südwestfalen

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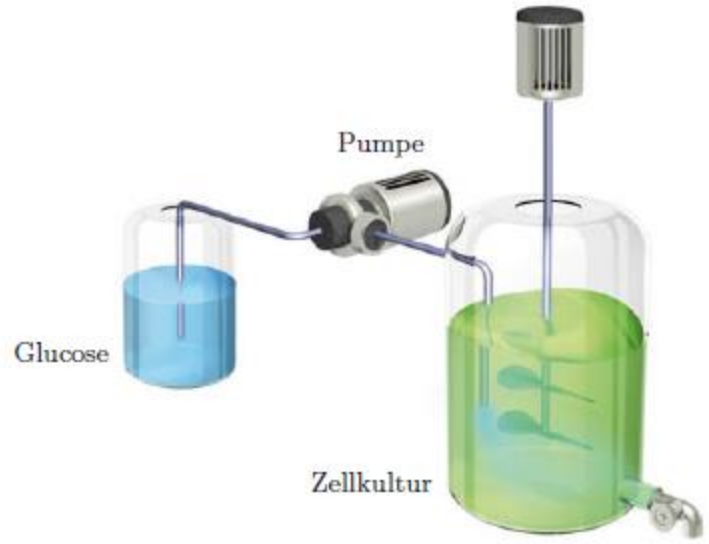
University of Applied Sciences

Hochschule für Technik und Wirtschaft

Abt. Soest

Assignment (Bioreactor):



Consider the bioreactor depicted above. The system can be modeled by the following state space system:

$$\dot{\boldsymbol{x}} = \boldsymbol{a}(\boldsymbol{x}) + \boldsymbol{b}(\boldsymbol{x}) \cdot u = \begin{bmatrix} \mu(x_2) \cdot x_1 \\ -\frac{1}{\alpha}\mu(x_2) \cdot x_1 \end{bmatrix} + \begin{bmatrix} -x_1 \\ K - x_2 \end{bmatrix} u,$$

$$y = g(\boldsymbol{x}) = [1\ 0]\, \boldsymbol{x}\,.$$

Where:

$$\mu(x_2) = \frac{\mu_0 x_2}{k_1 + x_2 + k_2 x_2^2}$$

- Maximal growth rate, $\mu_0 = 2$
- Affinity constant, $k_1 = 0.06$
- Affinity constant, $k_2 = 0.3$
- Feed concentration of glucose, K = 2
- Yield constant, $\alpha = 0.7$

The following tasks shall be performed:

1. Built a model of the system in Matlab/Simulink.

2. **Linearize** the system model in a suitable operation point.

3. Analyze the system behavior, i.e. **stability, controllability, observability** as necessary.

4. Design a **state space controller** based on either the **linear quadratic or pole placement** approach. In addition, design **a state observer.**

5. Analyse the controller design and record the obtained results as necessary.