

A Appendix

A.1 Systematic resampling

After the correction step, the ω_i normalized weights of the particles become available. As they are normalized, the cumulative sum of the weights is:

$$Q^{(m)} = \sum_{i=1}^m \omega_i \in [0, 1] \quad (1)$$

where $1 \leq m \leq N_S$.

During the systematic resampling, the $[0, 1]$ interval is divided into N_S subintervals equidistantly. From every subinterval, a z_j number is chosen. z_1 is randomly drawn from the uniform distribution on $(0, 1]$, and the others are determined by z_1 :

$$z_j = z_1 + \frac{j-1}{N_S}, \quad j = 2, 3, \dots, N_S \quad (2)$$

These z_j ($j = 1, 2, \dots, N_S$) values are used to select the new particles from the old ones. $\mathbf{x}_m$ is chosen when:

$$Q^{m-1} < z_j \leq Q^m \quad (3)$$

Therefore, the particles are selected with a probability equal to their weights. The new particles are considered to be of equal weights.

A.2 Derivation of the critical residence time and F_{max}

The critical residence time can be calculated in the following way:

$$b_{SRC} = (4Cn + (1-n)^2)R^2 + 2(2Cn + (1-n)^2)R + (1-n)^2 \quad (4)$$

$$\tau_{min}^* = \frac{1 + \frac{S_0}{K_S}}{2(\frac{S_0}{K_S} - (1 + \frac{S_0}{K_S})\frac{k_d}{\mu_m})} \cdot \frac{(1+n)(1+R) - \sqrt{b_{SRC}}}{n} \quad (5)$$

where τ_{min}^* refers to the dimensionless critical residence time and n denotes the volume ratio of the two reactors. As the reactor volumes are assumed to be equal, $n = 1$ in the present case, therefore, Equations 4 and 5 are simplified to the following forms:

$$b_{SRC} = 4CR^2 + 4CR \quad (6)$$

$$\tau_{min}^* = \frac{1 + \frac{S_0}{K_S}}{2(\frac{S_0}{K_S} - (1 + \frac{S_0}{K_S})\frac{k_d}{\mu_m})} \cdot (2(1 + R) - \sqrt{b_{SRC}}) \quad (7)$$

F_{max} can be calculated from τ_{min}^* :

$$F_{max} = \frac{V\mu_m}{\tau_{min}^*} \quad (8)$$