Analysis of the Structural Kinetic Model

The experimentally observed operating point is stable for most realizations of the Jacobian. Fig. 8 shows the percentage of stable models with respect to ensemble size (number of realizations). As we are mostly interested in typical realizations, the percentage of stable models converges rather fast - despite the large number of parameters.

Figure 8: Convergence and dependence on ensemble size of the relative fraction of stable models as a function of the number of realizations of the Jacobian. All saturation parameters are sampled from a uniform distribution $\theta^\mu_x \in [0, 1]$.

Similar to the glycolytic pathway, we examine the impact of individual reaction steps upon the stability of the system. Or rather, vice versa, ask whether there are specific values of saturation parameters that would make the system prone to instability. Fig. 9 shows such a scenario, together with the unrestricted distribution of the largest real part within the spectrum of eigenvalues. Since most models have $\lambda_{\text{max}}^\text{R} < 0$, we compare the distribution of saturation parameters for models with $\lambda_{\text{max}}^\text{R} > 0$ to the initial distribution. Marked changes are found for the triosephosphate isomerase (TBI: GAP $\leftrightarrow$ DHAP) with respect to GAP and for the G3P dehydrogenase (G3Pdh: BPGA$+\text{NADPH} \leftrightarrow \text{GAP} + \text{NADP} + \text{Pi}$) with respect to BPGA, see Fig. 10. In both cases high saturation ($\theta^\mu_x$ small) leads to instability, as is verified in Fig. 9. Note that both reactions are not saturated in the original model, thus avoiding the instability.