Intrafaculty Colloquium: Mathematics and Physics

UNI FREIBURG

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17.1.2014, 14:15, SR404, Institute of Mathematics

Gauge invariance of the log-likelihood functional – Lie-group theory & biology

Gauge invariance plays an important role in many physical theories. In a broader sense it can be defined as the invariance of an observation with respect to changes of internal variables. In cell biology, one often faces a similar problem. Due to limitations in the available experimental data, usually only a small fraction of the relevant protein concentrations can be measured.
To model cellular reaction networks, it is common to use ordinary differential equations (ODE). Therefore, in order to find gauge invariances in these systems, Lie-group theory can be applied. In many cases such an analysis yields symmetry transformations on the internal variables, i.e. the ODE states corresponding to the cellular concentrations, which do not affect the observed quantities. Thus, the log-likelihood functional is invariant under these transformations. The symmetries can then be used to reduce the number of parameters.

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