Contraction – memory – time scales [nln15]

microscopic dynamics	⇒ contraction ⇒	stochastic dynamics
future state determined by present state alone	focus on subset of dynamical variables	future state determined by present and past states
deterministic time evolution of dynamic variables	⇓	ignoring memory of past makes dynamics of selected variables probabilistic
	judicious choice: slow variables and long time scales	deterministic time evolution of probability distributions and mean values
	⇓ ⇒	short memory of fast variables has little impact on dynamics of slow variables at long times

Comments:

- In a classical Hamiltonian system the deterministic time evolution pertains to canonical coordinates and functions thereof.

- The time rate of change of any such variable depends on the instantaneous values of all canonical coordinates.

- On the contracted level of description we seek a way of describing an autonomous time evolution of a subset of variables.

- For that purpose the information contained in the instantaneous values of the variables that do not belong to the subset is transcribed into previous values of the variables that do belong to the subset.

- The autononmous time evolution of the variables belonging to the subset thus includes memory of its previous values.

- Slow variables contribute long memory and fast variables contribute short memory.

- If the subset contains all slow variables then any effects on its autonomous time evolution contributed by the remaining variables involve only short memory.

- Effects of short memory are more easily accounted for than effects of long memory.