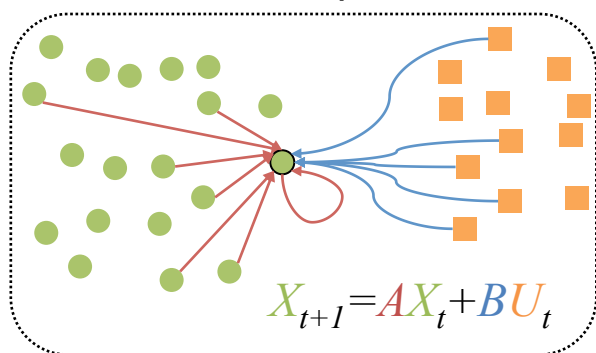
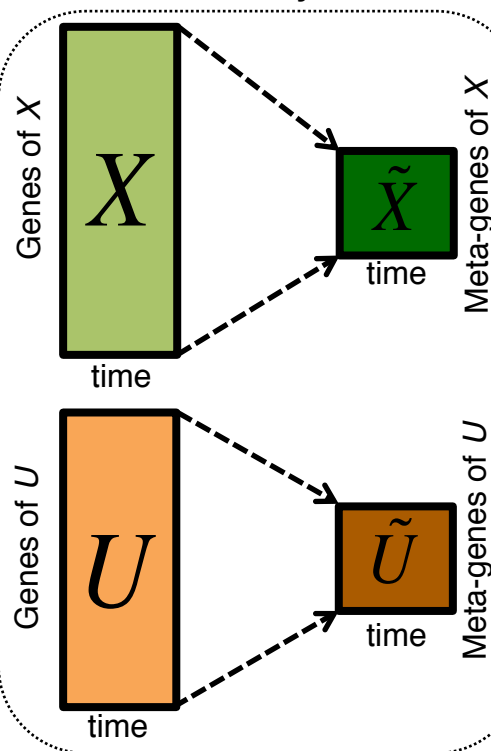


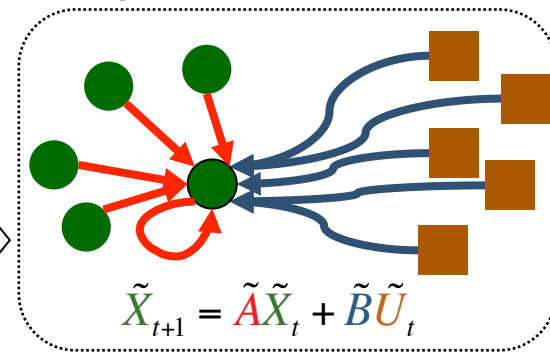
A. Gene state-space model



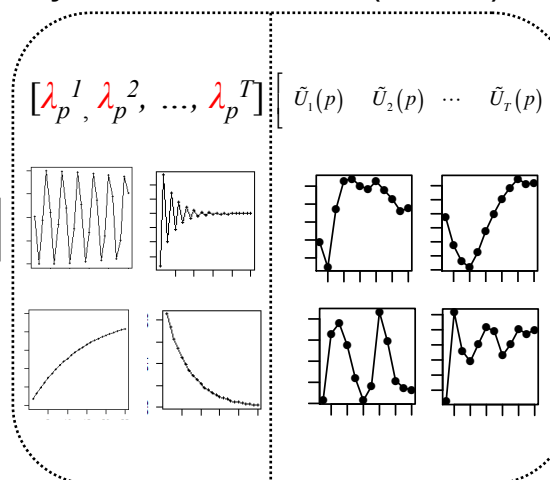
B. Dimensionality Reduction



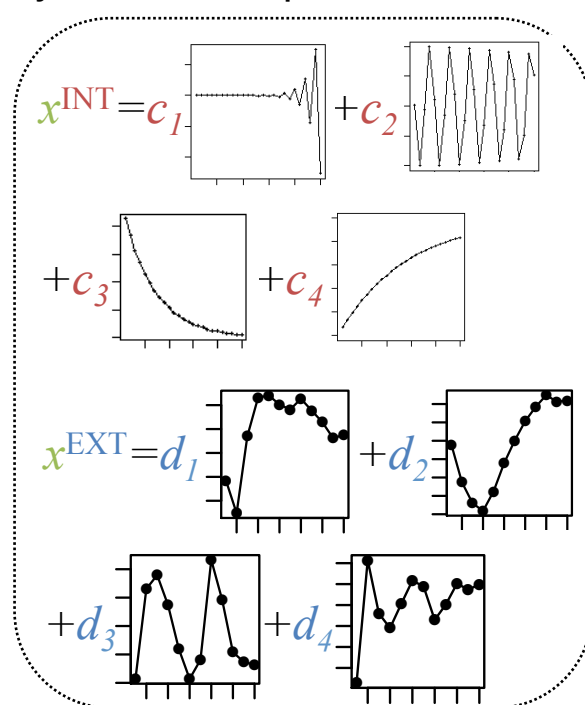
C. Meta-gene state-space model



D. Internal/External Principal Dynamic Patterns (PDPs)



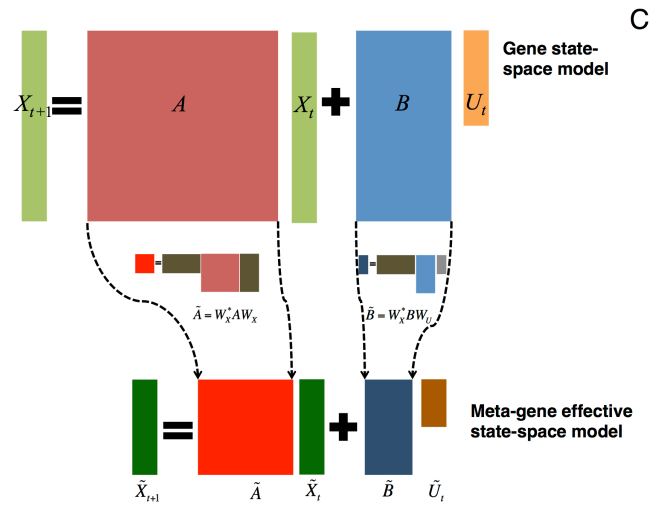
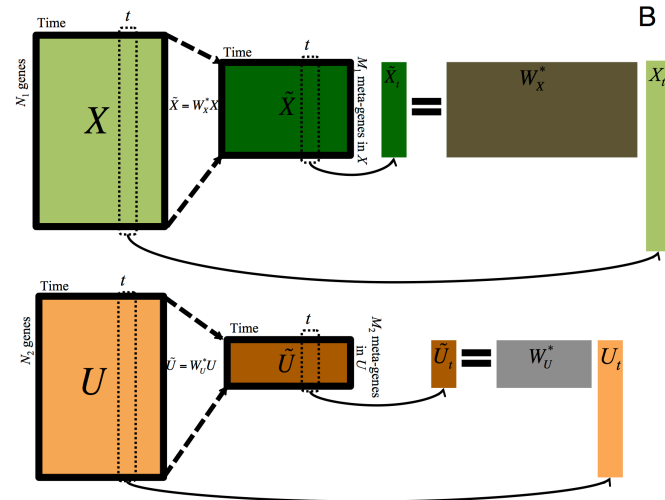
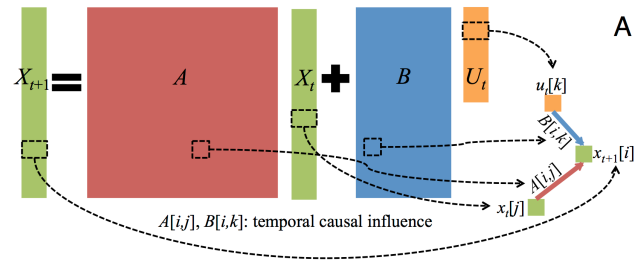
E. Gene's internal (INT) and external (EXT) driven expression dynamics composed of PDPs



← / ← Internal regulation among genes/meta-genes Group X by A/\tilde{A}

← / ← External regulation from genes/meta-genes in Group U to genes/meta-genes in Group X by B/\tilde{B}

● / ● Genes/Meta-genes in Group X ■ / ■ Genes/Meta-genes in Group U



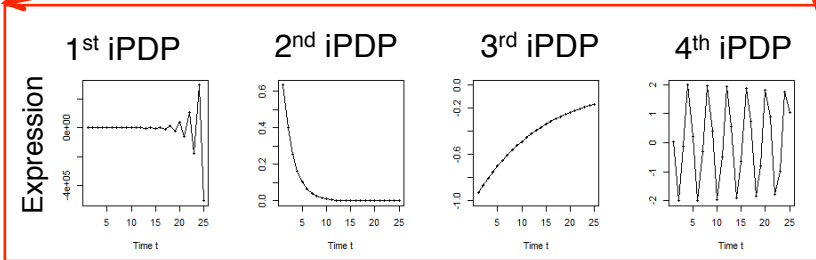
Worm's effective state space model

$$\tilde{X}_{t+1} = \tilde{A}\tilde{X}_t + \tilde{B}\tilde{U}_t$$

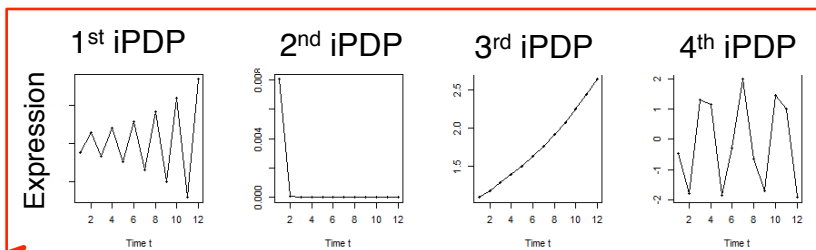


A

iPDPs: time exponentials
of \tilde{A} eigenvalues in worm



Similar iPDPs



iPDPs: time exponentials
of \tilde{A} eigenvalues in fly

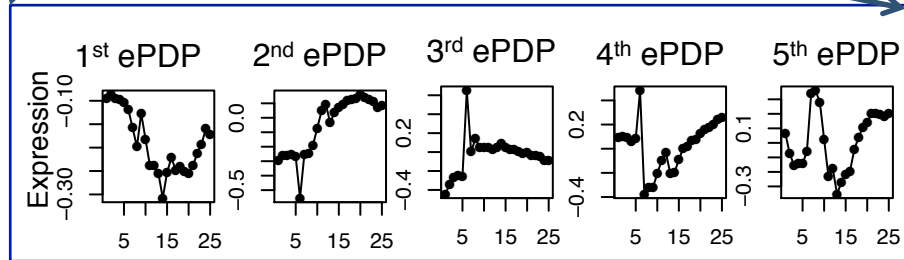
Fly's effective state space model

$$\tilde{X}_{t+1} = \tilde{A}\tilde{X}_t + \tilde{B}\tilde{U}_t$$

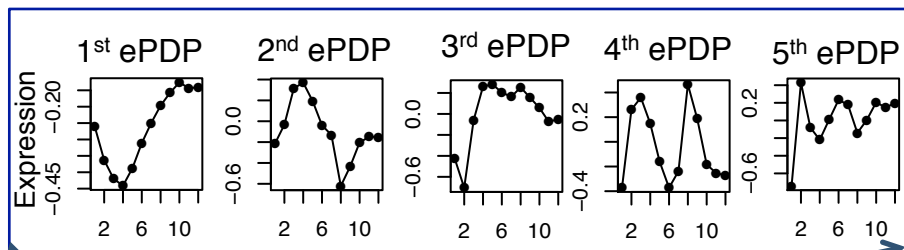


B

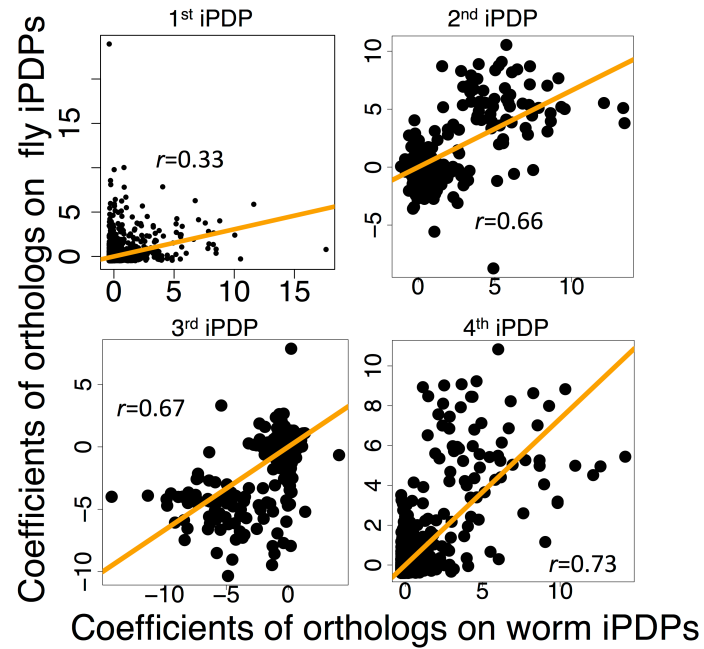
ePDPs: right singular
vectors of U in worm

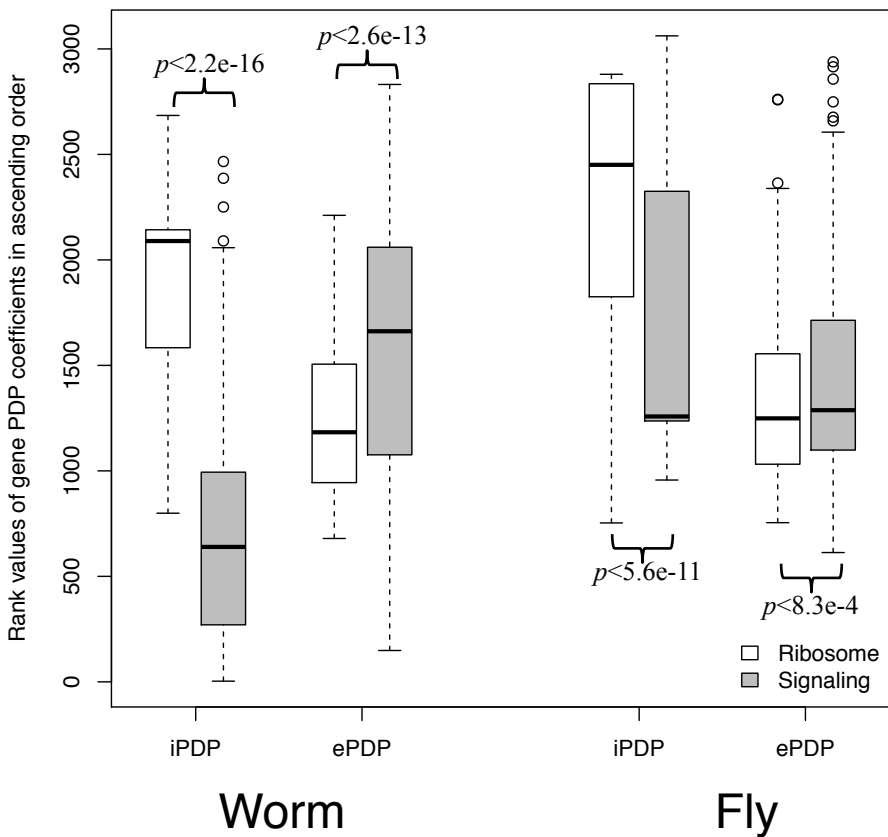


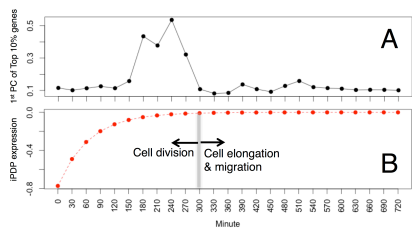
Different ePDPs



ePDPs: right singular
vectors of U in fly

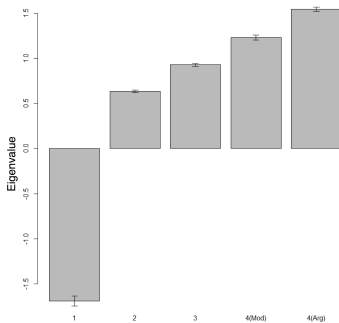
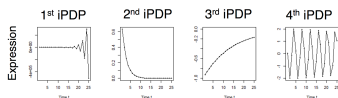




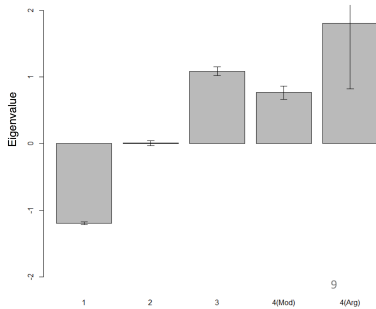
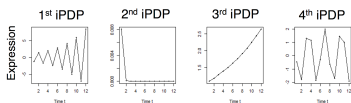


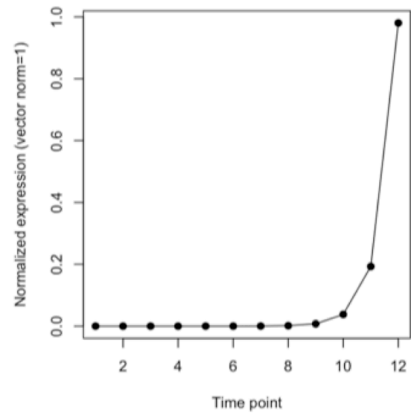
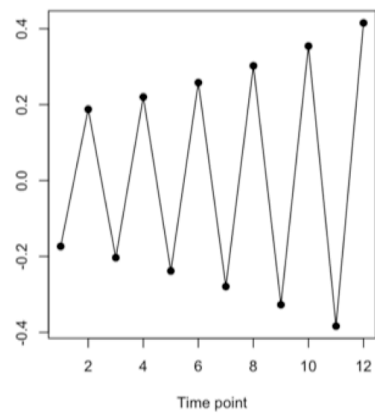
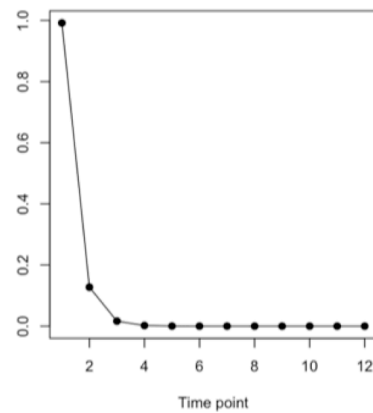
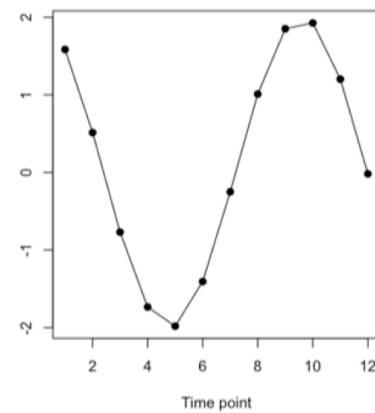
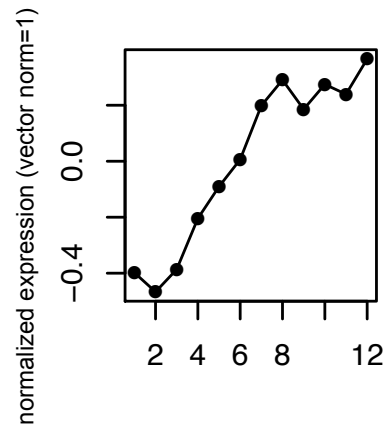
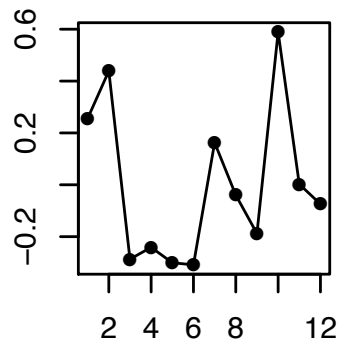
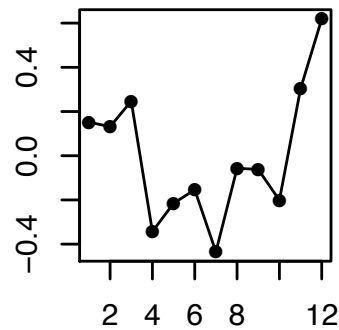
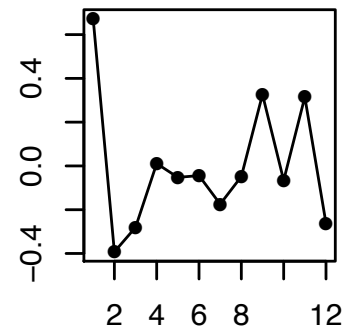
Worm Fly

canonical temporal expression trajectories



canonical temporal expression trajectories



iPDP 1**iPDP 2****iPDP 3****iPDP 4****ePDP 1****ePDP 2****ePDP 3****ePDP 4**

Time point