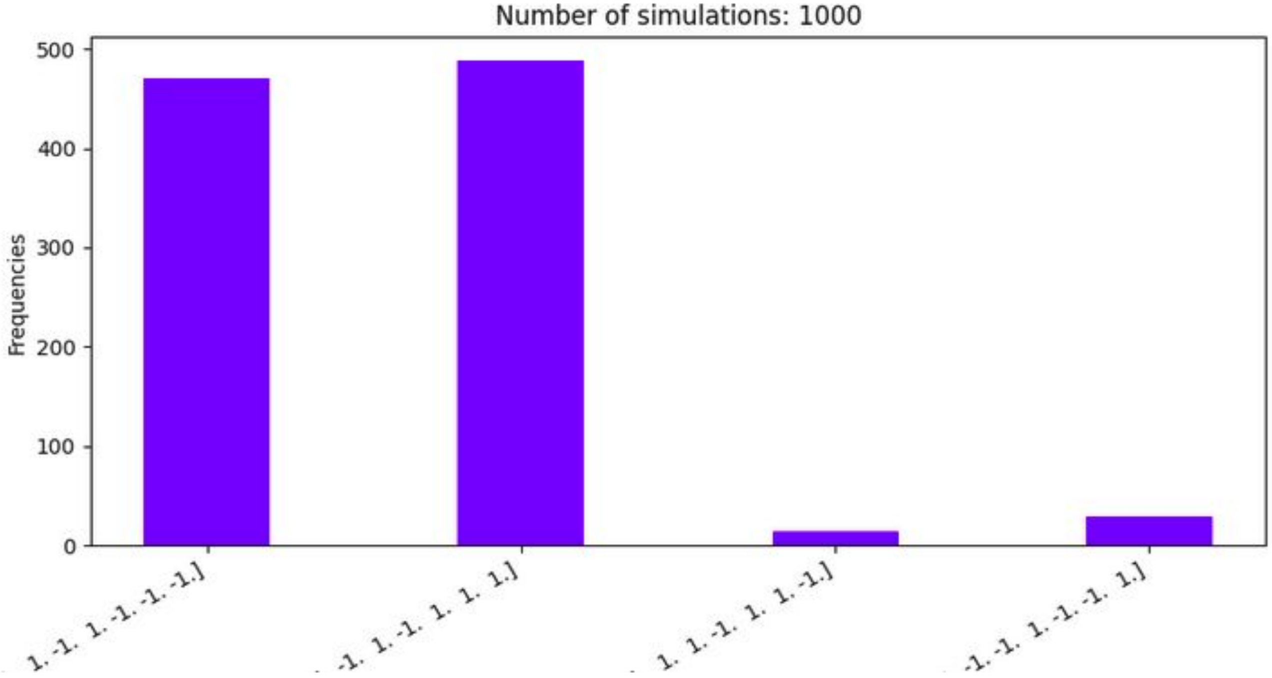
Turn-off formalism

Ising Formalism

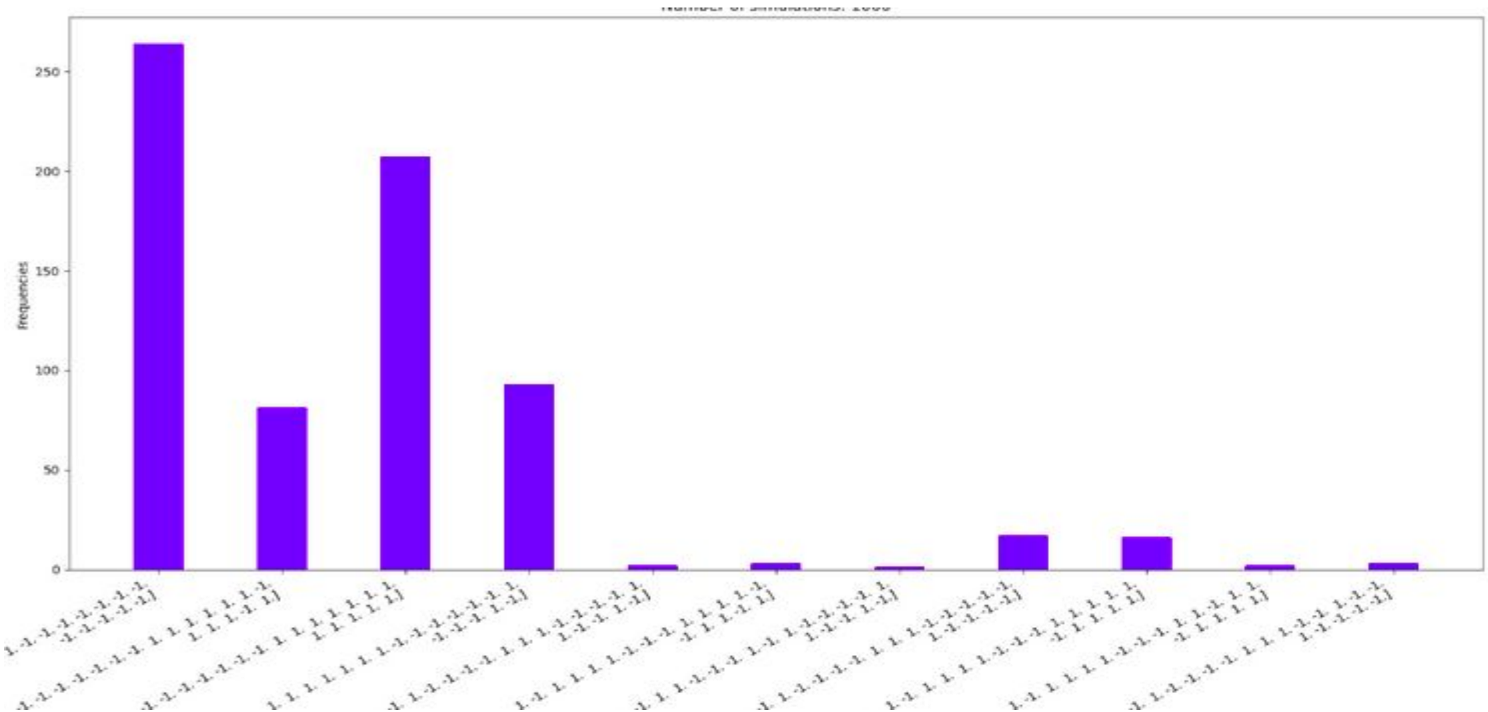
$$S_j = 1 \text{ if } \sum_i adj[i][j] * S_i > 0$$
$$S_j = -1 \text{ if } \sum_i adj[i][j] * S_i < 0$$
$$S_j = S_j \text{ if } \sum_i adj[i][j] * S_i = 0$$

In the case where the above sum is 0 we let the node have whatever state it had before and be somewhat 'unregulated'

The steady state distribution obtained with ising formalism for a 15 node emt network



The steady state distribution obtained with ising formalism for a 23 node emt network (1000 simulations)



Turn-off formalism (Three states)

When the sum is 0, we update the state of the node to be 0 instead of letting it be whatever it was.

$$S_j = 1 \text{ if } \sum_i adj[i][j] * S_i > 0$$

$$S_j = -1 \text{ if } \sum_i adj[i][j] * S_i < 0$$

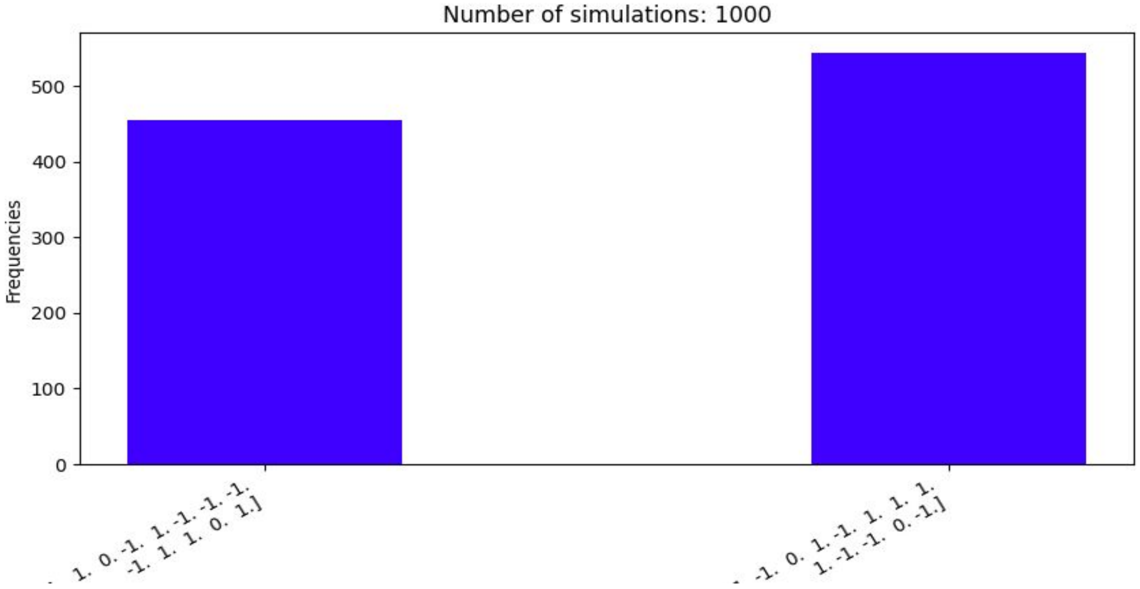
$$S_j = 0 \text{ if } \sum_i adj[i][j] * S_i = 0$$

What does it do?

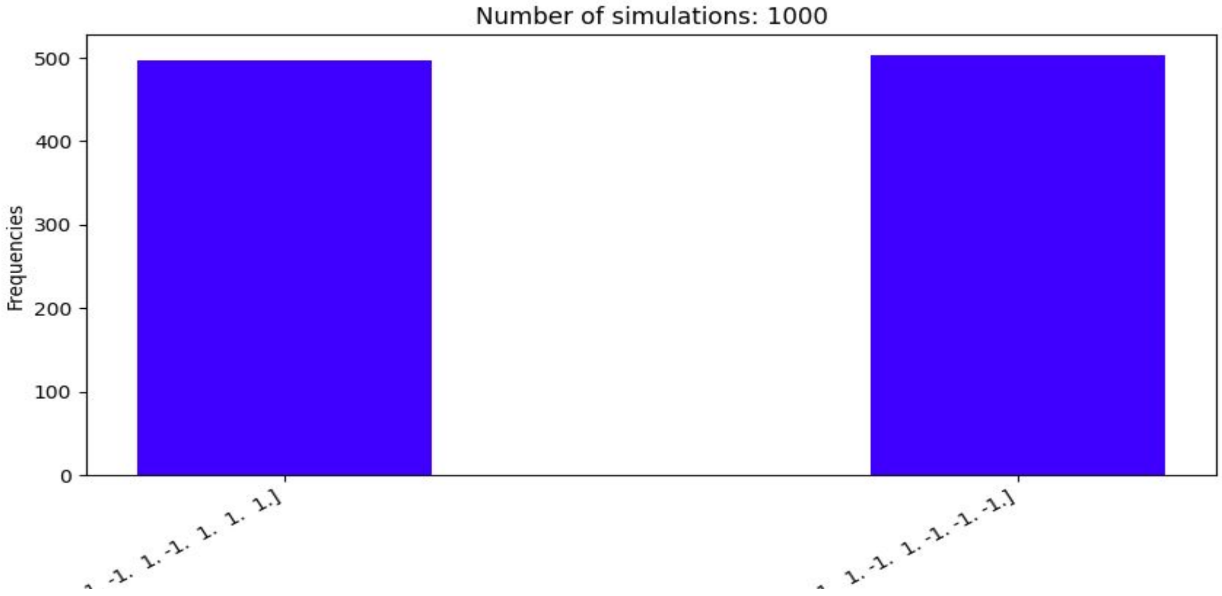
The turn off formalism effectively “silences” the nodes which have sum=0, in other words it disallows “unregulated/noisy nodes” to affect other nodes.

What we see after implementing this formalism is that hybrid states completely disappear in all the biological networks.

The steady state distribution obtained with turn-off formalism for a 23 node emt network



The steady state distribution obtained with turn-off formalism for a 15 node emt network

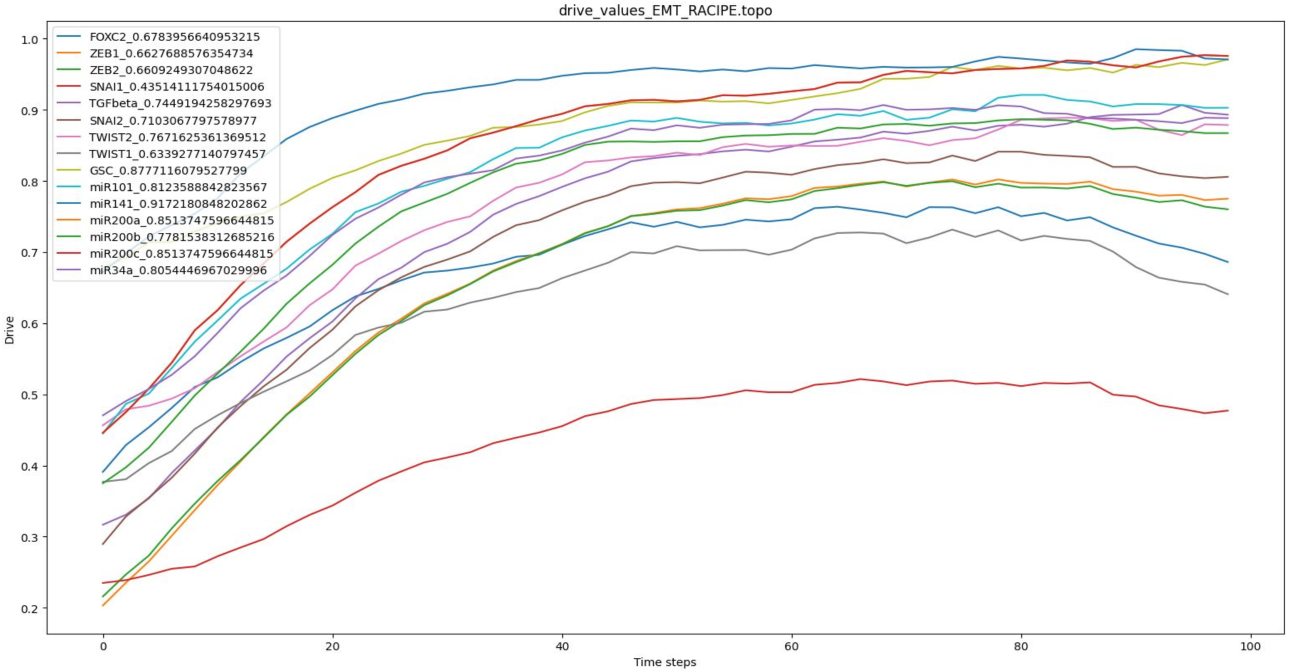


A new metric: Drive

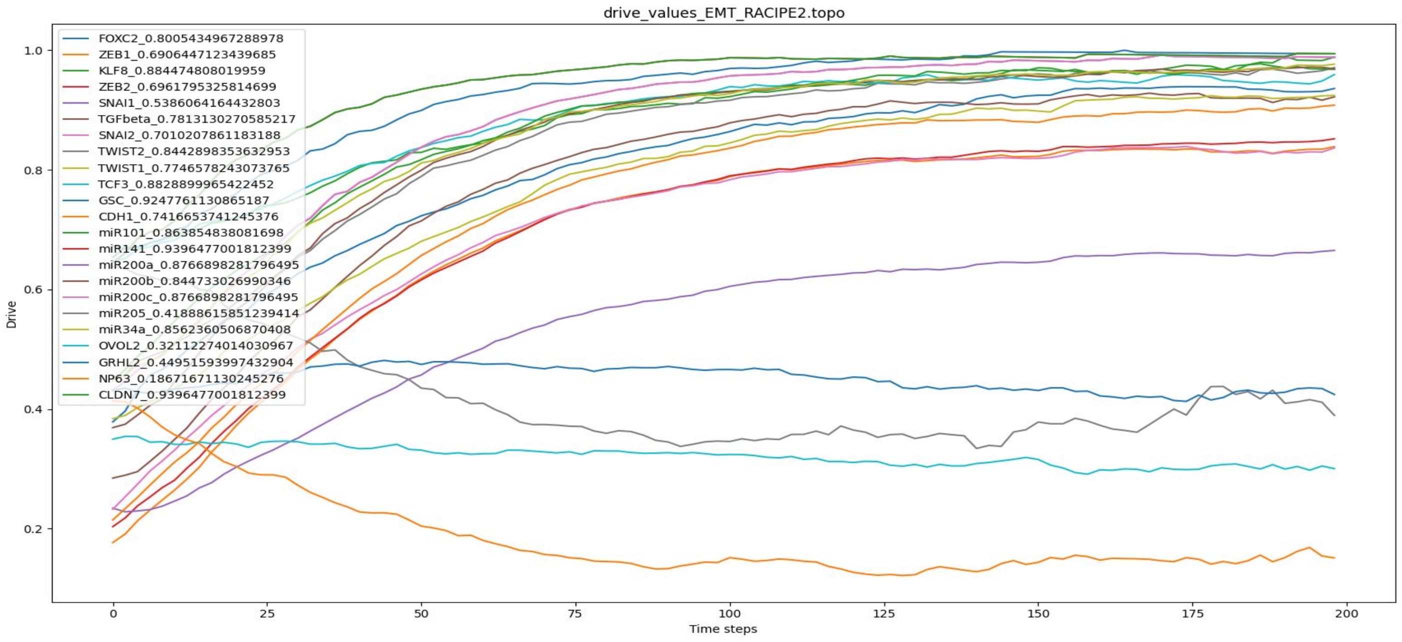
Since the three state formalism silences “noisy” nodes, we study a metric called drive which attempts at explaining how “noisy” a node is at a given time step during simulation. A node having 0 drive would be noisy and hence would be silenced. S_i is the state of the i’th node at the given time step of simulation and I_j is the indegree of j’th node

$$\frac{|\sum_i adj[i][j] * S_i|}{I_j}$$

Presence of noisy nodes in biological networks (SNAI1)



23 node EMT network (NP63,OVOL2,miR205, GRHL2)



Drive plots for pure artificial networks (density =0.3)