

## The scheme to merge small networks

Because  $k$  networks (NWs) can be integrated one by one, in the following we demonstrate the ‘merging’ algorithm recently integrated to GASA using two small NWs from Eq. (3) in the manuscript. Suppose that the 11 genes and two factors are involved in two small NWs, and specifically the first four equations and the last seven equations of Eq. (3) constitute these NWs. GASA is applied to two groups of genes and factors  $\Gamma_1 = \{f_1, f_2, g_1, g_2, g_3, g_4\}$  and  $\Gamma_2 = \{f_1, f_2, g_5, g_6, g_7, g_8, g_9, g_{10}, g_{11}\}$  to reconstruct these NWs.

The procedures are summarized as follows.

1. Calculate  $SSE/Var$  of genes in two small NWs, say  $\Gamma_1$  and  $\Gamma_2$ .
2. Add genes of  $\Gamma_2$  one by one into  $\Gamma_1$

For a given  $g_i$  in  $\Gamma_1$  (as a target gene), we add  $g_j$  from  $\Gamma_2$  (where  $j = 5, \dots, 11$ ) one at a time into  $i$ -th equation in Eq.(3) as a potential regulator. For ease of implementation, a regular SA is applied to estimate coefficients of the updated  $i$ -th equation. Among all potential links, the link resulting in the lowest value of  $SSE/Var$  in  $g_i$  will be added to  $\Gamma_1$  to form  $\Gamma'_1$ , and go to step 3.

3. Check network complexity

Compute the fitness score (AIC or BIC) of the merged network  $\Gamma'_1$ . If the fitness score is improved, this link and its associated gene in  $\Gamma_2$  are integrated into  $\Gamma_1$ . The  $SSE/Var$  value of gene  $g_i$  and the fitness score of  $\Gamma_1$  are both updated.

4. Repeat Steps 2-3 until no other links can improve the fitness score of  $\Gamma_1$ .
5. Repeat the same procedures to integrate the genes of  $\Gamma_1$  into  $\Gamma_2$ .

**Table 1.** The performances of GASA (with and without merging procedures) applied to the simulated NW from Eq. (3). The two small NWs were formed by the first four and last seven equations in Eq. (3), respectively. AIC and no power law restriction in the search space were applied with GASA.

| Data simulated with       | The inferred NW                            | TPR  | TNR  | FPR  |
|---------------------------|--------------------------------------------|------|------|------|
| No noise                  | One whole network                          | 0.81 | 0.99 | 0.05 |
|                           | One network merged from two small networks | 0.75 | 0.95 | 0.25 |
| Signal noise ratio<br>= 4 | One whole network                          | 0.66 | 0.97 | 0.22 |
|                           | One network merged from two small networks | 0.69 | 0.94 | 0.28 |