Appendix 1:

Psedo-code and computational complexity analysis

SpBLRSR

Input: $\boldsymbol{H_{SD}}$, $\boldsymbol{H_{SS}}$, $\boldsymbol{H_{DD}}$ and Ω

1: **Initialize:** $\boldsymbol{X^0} = \boldsymbol{M^0} = \boldsymbol{A^0} = \boldsymbol{C}^0 = \boldsymbol{Y_1^0} = \boldsymbol{Y_2^0} = 0$, $\delta = 0.01$, $\varepsilon = 1\text{e-}3$, $\lambda = 0.25$, $\mu = 4$, p=0.8, $\alpha = 0.4$;

2: $\boldsymbol{H} \leftarrow \begin{pmatrix} \boldsymbol{H}_{SS} & \boldsymbol{H}_{SD} \\ \boldsymbol{H}_{DS} & \boldsymbol{H}_{DD} \end{pmatrix}$;

3: **while** not converged **do**:

4: Fix others and update $\boldsymbol{X^{k+1}}$ by solving (13) and (14);

5: Fix others and update $\boldsymbol{M^{k+1}}$ by solving (16);

6: Fix others and update $\boldsymbol{A^{k+1}}$ by solving (19);

7: Fix others and update $\boldsymbol{C^{k+1}}$ by solving (21);

8: Fix others and update $\boldsymbol{Y_1^{k+1}}$ and $\boldsymbol{Y_2^{k+1}}$ by solving (22);

9: Check the convergence conditions $\|\boldsymbol{X}^{k+1} - \boldsymbol{X}^{k}\|_\infty < \varepsilon$, $\|\boldsymbol{M}^{k+1} - \boldsymbol{M}^{k}\|_\infty < \varepsilon$, $\|\boldsymbol{X}^{k+1} - \boldsymbol{M}^{k+1}\|_\infty < \varepsilon$

10: **End while**

11: **Output**: **C**omplete m^{7}G-disease block matrix $\boldsymbol{X}$

12: **Slice** the $\boldsymbol{X_{SD}}$ from $\boldsymbol{X}$

The computational complexity analysis of SpBLRSR is dominated by the updating process of $\boldsymbol{X}$, $\boldsymbol{M}$, $\boldsymbol{A}$, $\boldsymbol{C}$. For the sake of convenience, we denoted N as m+n. Hence, $\boldsymbol{X} \in \boldsymbol{R}^{N\times N}$, $\boldsymbol{M} \in \boldsymbol{R}^{N\times N}$, $\boldsymbol{A} \in \boldsymbol{R}^{N\times N}$, $\boldsymbol{C} \in \boldsymbol{R}^{N\times N}$.

Firstly, for updating $\boldsymbol{X}$, its updating rule (13) and (14) perform matrix addition operation 5 times, matrix multiplication operation 2 times, matrix inversion operation 1 time and hardmard product 1 time, thus the time complexity for updating $\boldsymbol{X}$ is $\boldsymbol{O}(3N^3)$. Additionally, GMST operation is applied on the updating of $\boldsymbol{M}$ with complexity $O(N^3)$. What's more, for updating $\boldsymbol{A}$, its updating rule (19) performs matrix addition operation 3 times, matrix multiplication operation 3 times and matrix inversion operation 1 time. In total, the complexity of updating $\boldsymbol{A}$ is $\boldsymbol{O}(4N^3)$. Finally, the time complexity for updating $\boldsymbol{C}$ is $\boldsymbol{O}(N^3)$. Thus, the time complexity of all the steps is $\boldsymbol{O}(9N^3)$. If the number of iteratisons is k, then the total complexity of SpBLRSR is $\boldsymbol{O}(9k*N^3)$.