**MDHGI: Matrix Decomposition and Heterogeneous Graph Inference for miRNA-disease association prediction** Xing Chen1, \*, Jun Yin1, Jia Qu1, Li Huang2

1School of Information and Control Engineering, China University of Mining and Technology, Xuzhou, 221116, China

2 Business Analytics Centre, National University of Singapore, 119613, Singapore

\*Corresponding author

**Email**: [xingchen@amss.ac.cn](mailto:xingchen@amss.ac.cn)

**Theorem 1.** When **** and **** are properly normalized utilizing Eq. (3) and Eq. (2) respectively, it is guaranteed that Eq. (1) will converge.

 (1)

 (2)

 (3)

**Proof of Theorem 1**

In order to make the whole proof process more concise, we denote *SR*, *SD* and *P* to *A*, *B* and *X* respectively where *A*, *B* and *X* are ,  and  matrices respectively. Besides, we denote  and  as the  row of *A* and column of *A* respectively.  is used to represent the value of *.* We use the similar way to define the matrix *B* and *X*. After that, based on Eq. (1), we can obtain:

 (4)

As for , we can also get

(5)

Here we use  to denote  and then Eq. (1) can be written as:

 (6)

Let *C* denote  and , , , ,, , , .

Then we can get  and .

Through comparing the above two equations, we can find that *C* is a  symmetrical matrix. The Eq. (6) can be written as follows after using  to represents :

 (7)

Since we wish to get a converged solution for Eq. (7), *C* can be normalized as , where *D* is a diagonal matrix with  equals to the sum of the  row of *C.* Hence, we can also get  and  where . After incorporating the above equation into , we can obtain:

 (8)

Therefore, if we normalize *A* and *B* as  and 

We can get . Thus, we can rewrite Eq. (7) as  with this equation.