**fileS1 Preliminary of LRTCLS**

### 3.1 Preliminaries

Before further discussion, we introduced the mathematical notations and fundamental formulas used in the paper. Tensors of order three are denoted by bold, calligraphy letters, e.g. ****, **,** matrices are denoted by italic, bold uppercase letters, e.g. ***X***, ***Y***, and scalars are denoted by italic, lower case letter, e.g. *x*, *y*. Additionally, ***X***(*v*)denotes the *v*-th frontal slice of tensor ****. Operation vec(****) is to vertically stack all column fibers of tensor ****into a tall vector in the sequence of its frontal slice.

**Inner product of tensor** The inner product of two tensors is defined as



Especially, 

***n*-mode product of tensor and vector** The *n*-mode products of a three order tensorand three matrices , ,are denoted by ，, , where

,





**Tucker Decomposition** A Tucker decomposition of is



where （***C***1<***I***1 , ***C***2<***I***2 , ***C***3<***I***3）is the core tensor, and each  is an orthogonal factor matrix. For details of tucker decomposition, please see [22].

**Projection Operator** Theprojection operator ***P***Ω onto a tensor **** is denoted by



where Ωis a set containing index pair (*i*1, *i*2, *i*3) of all known entries in****. What’s more, projection operator ***P***Ω is a self-adjoint operator, and its adjoint operator is denoted by ***P***Ω\*. The properties we used in this paper are listed below.

