origin

K: constraint

M: a generating matrix, with two parts (M_0: lattice generator and M_1: primitive sphere centers)

Λ: a lattice

Convex particle

A particle i is specifies by $\mathbf{K_i} = (\mathbf{R_i}, \mathbf{r_i})$. A translation by $\mathbf{t}$ is given by $(\mathbf{R_i}, \mathbf{r_i} + \mathbf{t})$. Similarly, a rotation is given by convXR, where R is a dd orthogonal matrix. Let P be the set of configuration parameters of any convex particles. We define a generating matrix of the packing as a $(d + (d + 1)p) \times d$ matrix M whose first d rows are a set of generators of Λ and whose remaining rows are the vectors in the set P. 要注意这里 R 是按列还是按行，此处默认按列吧。

For periodic packing, The set of all vertex matrices of polytopes in the packing is the Minkowski sum,

$$\Lambda + P = \left\{\mathbf{b}_0\mathrm{M}_0 + \mathbf{Y} : \mathbf{b}_0 \in \mathbb{Z}^d, \mathbf{Y} \in P\right\} = \left\{\mathbf{bM} : \mathbf{b} \in \mathbb{Z}^d \oplus E_p\right\}$$

where M ($\mathbf{M_0}$+$\mathbf{R}$+$\mathbf{r}$) is a generating matrix of the packing, and E_p is the set of coordinate permutations of the p-dimensional vector (1,0,0, . . . ,0).

For any nondegenerate matrix M, only finitely many independent exclusion constraints are violated or are even remotely close to being violated. We call those constraints the relevant exclusion constraints (let there be n of them), and we define a matrix A whose rows $\mathbf{a}_{2i-1}$ and $\mathbf{a}_{2i}$ are the vectors $\mathbf{b_1}$ and $\mathbf{b_2}$ related to the ith relevant exclusion constraint.

Exclusion constraint: K_{2i-1} and K_{2i} do not overlap.

Map: M-> $X = AM$, $2n \times d = 2n \times () * () \times d$, where $() = (d + (d + 1)p)$