1.110: Vector space

For each pair of points X and Y in point space one can draw a vector **r** from X to Y. The set of all vectors forms a **vector space**. The vector space has no origin but instead there is the *zero vector* which is obtained by connecting any point X with itself. The vector **r** has a *length* which is designed by |**r**| = r, where r is a non–negative real number. This number is also called the *absolute value* of the vector. The maximal number of linearly independent vectors in a vector space is called the *dimension of the space*.

An essential difference between the behavior of vectors and points is provided by the changes in their coefficients and coordinates if a different origin in point space is chosen. The coordinates of the points change when moving from an origin to the other one. However, the coefficients of the vector **r** do not change.

The point space is a dual of the vector space because to each vector in vector space a pair of points in point space can be associated.

Face normals, translation vectors, Patterson vectors and reciprocal lattice vectors are elements of vector space.