



G2O Edge Types

1. 2D SLAM

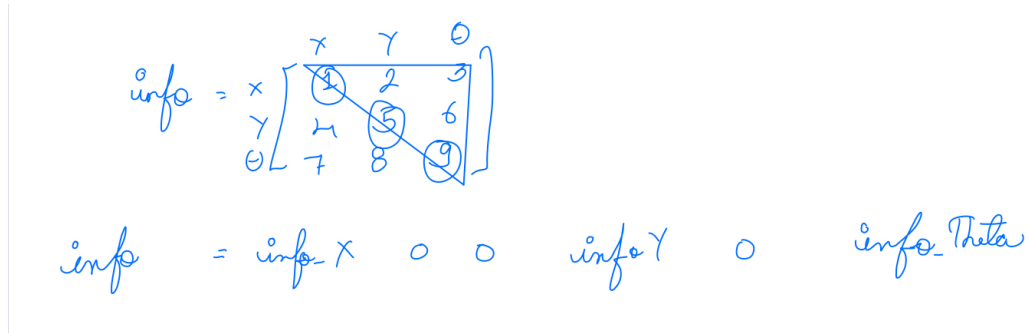
a. VERTEX_SE2 :

- i. VERTEX_SE2 i x y theta
- ii. Euclidean groups are the transformations of the space that preserve the Euclidean distance between any two points, also known as rigid body transformations.
- iii. The Euclidean group $E(n)$ comprises all translations, rotations, and reflections and arbitrary finite combinations of them.
- iv. We're interested in: **Special Euclidean Group $SE(n)$** which comprise arbitrary combinations of translations and rotations, but not reflections.
- v. i is the robot's i 'th position in the world fixed frame.
- vi. $x_i = (x, y, \theta)^T$

b. EDGE_SE2 :

- i. EDGE_SE2 i j x y theta info(x, y, theta)
- ii. This edge represents T_j^i , i.e transformation of j with respect to i . And x, y , and θ are relative transforms of j wrt i .

- iii. `info(x, y, theta)` is the information matrix that represents the confidence in the measurement and it is the inverse of the covariance matrix. Hence, it is symmetric and positive semi-definite. We typically only store the upper-triangular block of the matrix in row-major order.



$$\text{info} = \begin{bmatrix} 1 & 4 & 6 \\ 4 & 2 & 8 \\ 6 & 8 & 9 \end{bmatrix}$$

$$\text{info} = \text{info}_x \quad 0 \quad 0 \quad \text{info}_y \quad 0 \quad \text{info}_{\theta}$$

- iv. Generally, we treat x, y, θ as independent variables. And only weigh the diagonal entries of the information matrix.

For practical purposes, all the non diagonal elements of information matrix will be 0. As you've seen in 1D SLAM solved example.

c. `FIX 0`

2. 3D SLAM

a. `VERTEX_SE3`

i. `VERTEX_SE3:QUAT i x y z q_x q_y q_z q_w`

ii. i is the robot's i 'th position in the world fixed frame.

iii. Quaternions are used to represent the rotation.

b. `EDGE_SE3`

i. `EDGE_SE3:QUAT i j x y z q_x q_y q_z q_w info(x, y, z, $\theta_x, \theta_y, \theta_z$)`

ii. This edge represents: T_j^i , i.e transformation of j with respect to i .

iii. Though relative transformation is measured in quaternion, the information matrix is measured in Euler angles.

info

$$= \begin{matrix} x \\ y \\ z \\ \theta_x \\ \theta_y \\ \theta_z \end{matrix} = \begin{bmatrix} x & y & z & \theta_x & \theta_y & \theta_z \\ 1 & 2 & 3 & 4 & 5 & 6 \\ & 7 & 8 & 9 & 10 & 11 \\ & & 12 & 13 & 14 & 15 \\ & & & 16 & 17 & 18 \\ & & & & 19 & 20 \\ & & & & & 21 \end{bmatrix}$$