B_I:Base position between base and robot $\varphi_{i,i}$: Phase measument $\phi_{I-1,I-1}$ $\phi_{J-1,1}$ $\phi_{I-1,0}$ $\mathbf{X_1}$ $\mathbf{Z_{1,I-1}}$ \mathbf{z}_{i_2,i_1} :Odometory \mathbf{x}_i : Robot position $\Phi_{0,I-1}$ $\varphi_{0,1}$ $\varphi_{0,0}$ Fixed Base $\phi_{1,1}$ $/\phi_{1,I-1}$ Odometry Robot $\hat{X} = argmin \sum_{i} \| \underbrace{\mathbf{e}_{\mathrm{OD},i+n,i}}_{\mathbf{Odometry~error~term}}$ $||e_{\mathrm{PH},i+n,i,j}||_{\Omega_{\mathrm{PH},i+n,i,j}}$ Carrier phase error term • Two types of sensor data with different characteristics are

Carrier phase measurement

- integrated using graph optimization
- Simultaneously estimate the positions of the bases and the robot