

$$l_{ij}^2 = d_{ij}^T \cdot d_{ij}$$

$$\delta q \Leftrightarrow (\delta q_i, \delta q_j) \Leftrightarrow (\delta r_i, \delta \varphi_i, \delta r_j, \delta \varphi_j)$$

$$\underbrace{\delta l}_{\downarrow} \\ \downarrow \\ 2l \delta l$$

$$\underbrace{\delta d_{ij}}_{\downarrow} \\ \downarrow \\ 2d_{ij}^T \cdot \delta d_{ij}$$

$$2l \delta l = 2d_{ij}^T \cdot \delta d_{ij}$$

$$\Downarrow \\ l \delta l = d_{ij}^T \cdot \delta d_{ij}$$

$$\Downarrow \\ \delta l = \frac{d_{ij}^T}{l} \cdot \delta d_{ij}$$

$$\Downarrow \\ \delta l = \frac{d_{ij}^T}{l} \cdot (\delta r_j + \delta \varphi_j B_j \bar{s}_j^P - \delta r_i - \delta \varphi_i B_i \bar{s}_i^P)$$