- Key ideas of bundle adjustment
  - start with inital guess.
  - project estimated 3D points into estimated camera images.
  - compare location between projected 3D points with measured 2D points.
  - Adjust to minimize error in the images.

- Coefficient Matrix

$$\Delta X = \begin{vmatrix} \Delta K \\ \Delta t \end{vmatrix} \quad \begin{matrix} \Delta K \to \text{3D points} \\ \Delta t \to \text{6D orientation parameters} \end{matrix}$$

$$\underbrace{\Delta l}_{\text{Observations}} + \underbrace{v}_{\text{corrections}} = \overbrace{A}^{\text{Jacobian}} \underbrace{\Delta X}_{\text{3D points}}$$

Let try to split A into $\overset{\text{2x6 matrix}}{B}$ and $\overset{\text{2x3 matrix}}{C}$ $= \begin{vmatrix} C & B \end{vmatrix} \begin{vmatrix} \Delta K \\ \Delta t \end{vmatrix} = C\Delta K + B\Delta t$

A is a jacobian which is of size $2 \times U$, where U is number of unkowns. However, because we know that C depends only on 3 and B only on 6 values. This is much better than using A with potential millions of unkown. One thing to note is that matrix B and C will be different for every point. This means that majority points in A must be zero and not matter.

$$A = \begin{vmatrix} A \\ \vdots \\ A_{ij} \end{vmatrix} = \text{Coefficient Matrix}$$

$$= \left[0,0,0 \ldots B_{ij}^T \ldots \middle| 0 \ldots C_{ij}^T \ldots 0 \right]$$

= sparse matrix, made mostly of zeros.

- So, a key point is ... only the point we are observing and the camera that is observing the point, can tell us something about where the point will be mapped to. All other points and Cameras have no impact.