then an optimal set of a_k can be found by minimizing

$$J_i(a_1, ..., a_n, e) = \sum_{k=1}^{n} ||(\vec{m} + a_k\vec{e}) - \vec{x_k}||^2 \tag{5}$$

$$J_i(a_1, ..., a_n, e) = \sum_{k=1}^{n} ||a_k\vec{e} - (\vec{x_k} - \vec{m})||^2 \tag{6}$$

$$= \sum_{k=1}^{n} a_k^2||\vec{e}||^2 - 2\sum_{k=1}^{n} a_k\vec{e}^T(\vec{x}_k - \vec{m}) + \sum_{k=1}^{n} ||\vec{x_k} - \vec{m}||^2 \tag{7}$$