

Since  $\mathbf{U}$  is orthogonal holds  $\mathbf{U}^T \mathbf{U} = I$

$$w_i^T w_j = (Uv_i)^T (Uv_j) = v_i^T U^T U v_j = v_i^T I v_j = v_i^T v_j \quad (1)$$