Figure 2: 3D representation of the two vectors $V$ and $V_{\Delta}$ for a given distance $d = 1$ and $\theta = 45^\circ$.

corresponds to $V$ and $V_{\Delta}$ components. The use of this structure can help us to compute the occurrences while keeping the corresponding components vectors of $V$ and $V_{\Delta}$. For example if we take the first value of $I_{occu}$ (i.e $I_{occu}(1)$ ), the corresponding components vectors of $V$ and $V_{\Delta}$ are in the first row of $M_{V,V_{\Delta}}$ (see Fig.3), so $I_{occu}(1|d,\theta) = P(V^{(1)},V_{\Delta}^{(1)}|d,\theta)$ where $V^{(1)} = M_{V,V_{\Delta}}(1,1 : n)$ and $V_{\Delta}^{(1)} = M_{V,V_{\Delta}}(1,n + 1 : 2 \times n)$.

$(1 : n)$: designs columns 1 to n.

In order to compute the matrix $M_{V,V_{\Delta}}$, we define two sub-tensors $A$, $B$ extracted from the tensor data $X$ for each direction $\theta$ as shown in Fig.4. Using the 3-mode flattening matrix of $A$, $B$, we obtain respectively $A_3$, $B_3$. Let $T$ denotes the matrix that horizontally concatenates $A_3^t$ and $B_3^t$, and vertically concatenates $B_3^t$ and $A_3^t$, where $A_3^t$, $B_3^t$ denote the transposed matrices of $A_3$, $B_3$ respectively. $T$ can be represented as follows:

$$ T = \begin{pmatrix} A_3^t & B_3^t \\ B_3^t & A_3^t \end{pmatrix} $$

(1)