My optimization problem is as follows,

$$\begin{cases} min_{\boldsymbol{X}\in \mathbb{C}^{N\times M}} \ f(\boldsymbol{X}) \\ s.t. |\boldsymbol{x}_m(i)| = 1, i = 0, \dots, N-1, m = 1, \dots, M, \end{cases}$$

where the matrix $\boldsymbol{X}$ is as $\boldsymbol{X} = [\boldsymbol{x}_1 \ \boldsymbol{x}_2 \ \ \dots \ \ \boldsymbol{x}_M]$. If we define the matrix of gradients $\nabla_{\boldsymbol{X}} f(\boldsymbol{X}) = [\nabla_{\boldsymbol{x}_1} f(\boldsymbol{X}), \ \nabla_2 f(\boldsymbol{X}), \dots \ \nabla_{\boldsymbol{x}_M} f(\boldsymbol{X}) \ ]$ and the matrix of search directions $\boldsymbol{V} = [\boldsymbol{v_1}, \boldsymbol{v_2}, \dots \boldsymbol{v_M}]$, where $\boldsymbol{v}_m = -\left(\nabla^2_{\mathbf{x}_\mathrm{m}} \mathrm{f}(\mathbf{X})\right)^{-1} \nabla_{\mathbf{x}_\mathrm{m}} \mathrm{f}(\mathbf{X})$, is it true to write Wolfe conditions as follows

$$\begin{cases} f(\boldsymbol{X} + \alpha \boldsymbol{V}) \ \le \ f(\boldsymbol{X}) \quad + c_1 \alpha < \nabla_{\boldsymbol{X}} f(\boldsymbol{X}), \boldsymbol{V} > \\ < \nabla_{\boldsymbol{X}} f(\boldsymbol{X} + \alpha \boldsymbol{V}), \boldsymbol{V} \ > \ge c_2 < \nabla_{\boldsymbol{X}} f(\boldsymbol{X}), \boldsymbol{V} >, \end{cases}$$

where $\langle \boldsymbol{A}, \boldsymbol{B} \rangle$ is the inner product of the matrices $\boldsymbol{A} = [\boldsymbol{a}_1, \boldsymbol{a}_2, \dots, \boldsymbol{a}_M]$ and $\boldsymbol{B} = [\boldsymbol{b}_1, \boldsymbol{b}_2, \dots, \boldsymbol{b}_M]$ that is defined as

$$\langle \boldsymbol{A}, \boldsymbol{B} \rangle = \sum_{i=1}^{M} \langle \ \boldsymbol{x}_i \ , \boldsymbol{y}_i \ \rangle$$