Assume $\mathbf{W}$ is a DFT matrix with transform length $N = 3$, and its Gram $\boldsymbol{W}^{*}\boldsymbol{W}$:

$$\mathbf{W} = \begin{pmatrix} a_{1,1} & a_{1,2} & a_{1,3} \\ a_{2,1} & a_{2,2} & a_{2,3} \\ a_{3,1} & a_{3,2} & a_{3,3} \end{pmatrix} \; \boldsymbol{W}^{*}\mathbf{W} = \begin{pmatrix} a_{1,1}{}^{2} + a_{2,1}{}^{2} + a_{3,1}{}^{2} & a_{1,1}a_{1,2} + a_{2,1}a_{2,2} + a_{3,1}a_{3,2} & a_{1,1}a_{1,3} + a_{2,1}a_{2,3} + a_{3,1}a_{3,3} \\ a_{1,1}a_{1,2} + a_{2,1}a_{2,2} + a_{3,1}a_{3,2} & a_{1,2}{}^{2} + a_{2,2}{}^{2} + a_{3,2}{}^{2} & a_{1,2}a_{1,3} + a_{2,2}a_{2,3} + a_{3,2}a_{3,3} \\ a_{1,1}a_{1,3} + a_{2,1}a_{2,3} + a_{3,1}a_{3,3} & a_{1,2}a_{1,3} + a_{2,2}a_{2,3} + a_{3,2}a_{3,3} & a_{1,3}{}^{2} + a_{2,3}{}^{2} + a_{3,3}{}^{2} \end{pmatrix}$$

Assume hop $L = 2$, construct frame operator $\mathbf{\Phi}$:

$$\mathbf{\Phi} = \begin{pmatrix} a_{1,1} & a_{1,2} & a_{1,3} & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{2,1} & a_{2,2} & a_{2,3} & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{3,1} & a_{3,2} & a_{3,3} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & a_{1,1} & a_{1,2} & a_{1,3} & 0 & 0 & 0 & 0 \\ 0 & 0 & a_{2,1} & a_{2,2} & a_{2,3} & 0 & 0 & 0 & 0 \\ 0 & 0 & a_{3,1} & a_{3,2} & a_{3,3} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & a_{1,1} & a_{1,2} & a_{1,3} & 0 & 0 \\ 0 & 0 & 0 & 0 & a_{2,1} & a_{2,2} & a_{2,3} & 0 & 0 \\ 0 & 0 & 0 & 0 & a_{3,1} & a_{3,2} & a_{3,3} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & a_{1,1} & a_{1,2} & a_{1,3} \\ 0 & 0 & 0 & 0 & 0 & 0 & a_{2,1} & a_{2,2} & a_{2,3} \\ 0 & 0 & 0 & 0 & 0 & 0 & a_{3,1} & a_{3,2} & a_{3,3} \end{pmatrix}$$

Main body of Gram $\mathbf{\Phi}^{*}\mathbf{\Phi}$:

$$\mathbf{\Phi}^{*}\mathbf{\Phi} = \begin{pmatrix} a_{1,2}{}^{2} + a_{2,2}{}^{2} + a_{3,2}{}^{2} & a_{1,2}a_{1,3} + a_{2,2}a_{2,3} + a_{3,2}a_{3,3} & 0 & 0 & 0 & 0 \\ a_{1,2}a_{1,3} + a_{2,2}a_{2,3} + a_{3,2}a_{3,3} & a_{1,1}{}^{2} + a_{1,3}{}^{2} + a_{2,1}{}^{2} + a_{2,3}{}^{2} + a_{3,1}{}^{2} + a_{3,3}{}^{2} & a_{1,1}a_{1,2} + a_{2,1}a_{2,2} + a_{3,1}a_{3,2} & a_{1,1}a_{1,3} + a_{2,1}a_{2,3} + a_{3,1}a_{3,3} & 0 & 0 \\ 0 & a_{1,1}a_{1,2} + a_{2,1}a_{2,2} + a_{3,1}a_{3,2} & a_{1,2}{}^{2} + a_{2,2}{}^{2} + a_{3,2}{}^{2} & a_{1,2}a_{1,3} + a_{2,2}a_{2,3} + a_{3,2}a_{3,3} & 0 & 0 \\ 0 & a_{1,1}a_{1,3} + a_{2,1}a_{2,3} + a_{3,1}a_{3,3} & a_{1,2}a_{1,3} + a_{2,2}a_{2,3} + a_{3,2}a_{3,3} & a_{1,1}{}^{2} + a_{1,3}{}^{2} + a_{2,1}{}^{2} + a_{2,3}{}^{2} + a_{3,1}{}^{2} + a_{3,3}{}^{2} & a_{1,1}a_{1,2} + a_{2,1}a_{2,2} + a_{3,1}a_{3,2} & a_{1,1}a_{1,3} + a_{2,1}a_{2,3} + a_{3,1}a_{3,3} \\ 0 & 0 & 0 & a_{1,1}a_{1,2} + a_{2,1}a_{2,2} + a_{3,1}a_{3,2} & a_{1,2}{}^{2} + a_{2,2}{}^{2} + a_{3,2}{}^{2} & a_{1,2}a_{1,3} + a_{2,2}a_{2,3} + a_{3,2}a_{3,3} \\ 0 & 0 & 0 & a_{1,1}a_{1,3} + a_{2,1}a_{2,3} + a_{3,1}a_{3,3} & a_{1,2}a_{1,3} + a_{2,2}a_{2,3} + a_{3,2}a_{3,3} & a_{1,3}{}^{2} + a_{2,3}{}^{2} + a_{3,3}{}^{2} \end{pmatrix}$$

An alternate method to construct Gram $\mathbf{\Phi}^{*}\mathbf{\Phi}$ without performing costly matrix multiplication:

Step 1 of overlap-add $\boldsymbol{W}^{*}\boldsymbol{W}$ along diagonal, main body of Gram $\mathbf{\Phi}^{*}\mathbf{\Phi}$:

$$\begin{pmatrix} a_{1,2}{}^{2} + a_{2,2}{}^{2} + a_{3,2}{}^{2} & a_{1,2}a_{1,3} + a_{2,2}a_{2,3} + a_{3,2}a_{3,3} & 0 & 0 & 0 & 0 \\ a_{1,2}a_{1,3} + a_{2,2}a_{2,3} + a_{3,2}a_{3,3} & a_{1,3}{}^{2} + a_{2,3}{}^{2} + a_{3,3}{}^{2} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

Step 2 of overlap-add $\boldsymbol{W}^{*}\boldsymbol{W}$ along diagonal, main body of Gram $\mathbf{\Phi}^{*}\mathbf{\Phi}$:

$$\begin{pmatrix} a_{1,2}{}^{2} + a_{2,2}{}^{2} + a_{3,2}{}^{2} & a_{1,2}a_{1,3} + a_{2,2}a_{2,3} + a_{3,2}a_{3,3} & 0 & 0 & 0 & 0 \\ a_{1,2}a_{1,3} + a_{2,2}a_{2,3} + a_{3,2}a_{3,3} & a_{1,1}{}^{2} + a_{1,3}{}^{2} + a_{2,1}{}^{2} + a_{2,3}{}^{2} + a_{3,1}{}^{2} + a_{3,3}{}^{2} & a_{1,1}a_{1,2} + a_{2,1}a_{2,2} + a_{3,1}a_{3,2} & a_{1,1}a_{1,3} + a_{2,1}a_{2,3} + a_{3,1}a_{3,3} & 0 & 0 \\ 0 & a_{1,1}a_{1,2} + a_{2,1}a_{2,2} + a_{3,1}a_{3,2} & a_{1,2}{}^{2} + a_{2,2}{}^{2} + a_{3,2}{}^{2} & a_{1,2}a_{1,3} + a_{2,2}a_{2,3} + a_{3,2}a_{3,3} & 0 & 0 \\ 0 & a_{1,1}a_{1,3} + a_{2,1}a_{2,3} + a_{3,1}a_{3,3} & a_{1,2}a_{1,3} + a_{2,2}a_{2,3} + a_{3,2}a_{3,3} & a_{1,3}{}^{2} + a_{2,3}{}^{2} + a_{3,3}{}^{2} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

Step 3 of overlap-add $\boldsymbol{W}^{*}\boldsymbol{W}$ along diagonal, main body of Gram $\mathbf{\Phi}^{*}\mathbf{\Phi}$:

$$\begin{pmatrix} a_{1,2}{}^{2} + a_{2,2}{}^{2} + a_{3,2}{}^{2} & a_{1,2}a_{1,3} + a_{2,2}a_{2,3} + a_{3,2}a_{3,3} & 0 & 0 & 0 & 0 \\ a_{1,2}a_{1,3} + a_{2,2}a_{2,3} + a_{3,2}a_{3,3} & a_{1,1}{}^{2} + a_{1,3}{}^{2} + a_{2,1}{}^{2} + a_{2,3}{}^{2} + a_{3,1}{}^{2} + a_{3,3}{}^{2} & a_{1,1}a_{1,2} + a_{2,1}a_{2,2} + a_{3,1}a_{3,2} & a_{1,1}a_{1,3} + a_{2,1}a_{2,3} + a_{3,1}a_{3,3} & 0 & 0 \\ 0 & a_{1,1}a_{1,2} + a_{2,1}a_{2,2} + a_{3,1}a_{3,2} & a_{1,2}{}^{2} + a_{2,2}{}^{2} + a_{3,2}{}^{2} & a_{1,2}a_{1,3} + a_{2,2}a_{2,3} + a_{3,2}a_{3,3} & 0 & 0 \\ 0 & a_{1,1}a_{1,3} + a_{2,1}a_{2,3} + a_{3,1}a_{3,3} & a_{1,2}a_{1,3} + a_{2,2}a_{2,3} + a_{3,2}a_{3,3} & a_{1,1}{}^{2} + a_{1,3}{}^{2} + a_{2,1}{}^{2} + a_{2,3}{}^{2} + a_{3,1}{}^{2} + a_{3,3}{}^{2} & a_{1,1}a_{1,2} + a_{2,1}a_{2,2} + a_{3,1}a_{3,2} & a_{1,1}a_{1,3} + a_{2,1}a_{2,3} + a_{3,1}a_{3,3} \\ 0 & 0 & 0 & a_{1,1}a_{1,2} + a_{2,1}a_{2,2} + a_{3,1}a_{3,2} & a_{1,2}{}^{2} + a_{2,2}{}^{2} + a_{3,2}{}^{2} & a_{1,2}a_{1,3} + a_{2,2}a_{2,3} + a_{3,2}a_{3,3} \\ 0 & 0 & 0 & a_{1,1}a_{1,3} + a_{2,1}a_{2,3} + a_{3,1}a_{3,3} & a_{1,2}a_{1,3} + a_{2,2}a_{2,3} + a_{3,2}a_{3,3} & a_{1,3}{}^{2} + a_{2,3}{}^{2} + a_{3,3}{}^{2} \end{pmatrix}$$

Method that performs overlap-add $\boldsymbol{W}^{*}\boldsymbol{W}$ along diagonal is in fact, equivalent to compute Gramian $\mathbf{\Phi}^{*}\mathbf{\Phi}$ directly