

Appendices

A. Decomposition of Line Constraint Term

$$\begin{aligned}
 E_l = \begin{array}{|c|c|} \hline E(0,0,0) & E(0,0,1) \\ \hline E(0,1,0) & E(0,1,1) \\ \hline E(1,0,0) & E(1,0,1) \\ \hline E(1,1,0) & E(1,1,1) \\ \hline \end{array} &= \begin{array}{|c|c|} \hline a & b \\ \hline c & d \\ \hline e & f \\ \hline g & h \\ \hline \end{array} \\
 &= A + \begin{array}{|c|c|} \hline 0 & 0 \\ \hline 0 & 0 \\ \hline p_1 & p_1 \\ \hline \end{array} + \begin{array}{|c|c|} \hline 0 & 0 \\ \hline p_2 & p_2 \\ \hline 0 & 0 \\ \hline \end{array} + \begin{array}{|c|c|} \hline 0 & p_3 \\ \hline 0 & p_3 \\ \hline 0 & p_3 \\ \hline \end{array} + \begin{array}{|c|c|} \hline 0 & p_{23} \\ \hline 0 & 0 \\ \hline 0 & p_{23} \\ \hline \end{array} + \begin{array}{|c|c|} \hline 0 & 0 \\ \hline 0 & 0 \\ \hline p_{31} & 0 \\ \hline \end{array} + \begin{array}{|c|c|} \hline 0 & 0 \\ \hline p_{12} & p_{12} \\ \hline 0 & 0 \\ \hline \end{array} + \begin{array}{|c|c|} \hline 0 & 0 \\ \hline 0 & 0 \\ \hline 0 & -p \\ \hline \end{array} \quad \begin{array}{l} p_1 = f - b \quad p_{23} = b + c - a - d \\ p_2 = g - e \quad p_{31} = b + e - a - f \\ p_3 = d - c \quad p_{12} = c + e - a - g \\ p = (a + d + f + g) - (b + c + e + h) \geq 0 \end{array} \\
 &= H + \begin{array}{|c|c|} \hline p_1 & p_1 \\ \hline p_1 & p_1 \\ \hline 0 & 0 \\ \hline \end{array} + \begin{array}{|c|c|} \hline p_2 & p_2 \\ \hline 0 & 0 \\ \hline p_2 & p_2 \\ \hline \end{array} + \begin{array}{|c|c|} \hline p_3 & 0 \\ \hline p_3 & 0 \\ \hline p_3 & 0 \\ \hline \end{array} + \begin{array}{|c|c|} \hline 0 & 0 \\ \hline p_{32} & 0 \\ \hline 0 & 0 \\ \hline \end{array} + \begin{array}{|c|c|} \hline 0 & p_{13} \\ \hline 0 & p_{13} \\ \hline 0 & 0 \\ \hline \end{array} + \begin{array}{|c|c|} \hline 0 & 0 \\ \hline 0 & 0 \\ \hline p_{21} & p_{21} \\ \hline \end{array} + \begin{array}{|c|c|} \hline p & 0 \\ \hline 0 & 0 \\ \hline 0 & 0 \\ \hline \end{array} \quad \begin{array}{l} p_1 = c - g \quad p_{32} = f + g - e - h \\ p_2 = b - d \quad p_{13} = d + g - c - h \\ p_3 = e - f \quad p_{21} = d + f - b - h \\ p = (a + d + f + g) - (b + c + e + h) < 0 \end{array}
 \end{aligned}$$

Table 2. We follow the \mathcal{F}^3 decomposition scheme from [15](Table 7 and 9) for E_l

We follow their decomposition and edge assignment schemes for \mathcal{F}^3 . Here we briefly reiterate this process. There are two possible decompositions of E_l . We first compute $p = (a + d + f + g) - (b + c + e + h)$. If $p \geq 0$, E_l can be decomposed using the upper branch of Table 2. We then assign the weights to edges as follows: 1) assign p to all four at -links in group at_1 ; 2) Assign p_1, p_2, p_3 to t -links for l_i, l_j , and l_k respectively, and finally assign p_{12}, p_{23}, p_{31} to an -links (n_i, n_j) , (n_j, n_k) , and (n_k, n_i) . If $p < 0$, we can decompose the table in a similar fashion as shown in the lower branch of Table 2 and assign the weights to edges accordingly.