We imitate the derivation in (1.1)-(1.2), modifying it to include the mutual inductance of both nearest neighbors. Kirchhoff’s current law yields the second of (1.1) (without the conductance term), while Kirchhoff’s voltage law applied around a loop containing the central inductor in the figure (observing the polarity and the dot convention) gives

\[
0 = (l\Delta z) \frac{\partial i(z,t)}{\partial t} + (m\Delta z) \frac{\partial i(z-\Delta z,t)}{\partial t} + (m\Delta z) \frac{\partial i(z+\Delta z,t)}{\partial t} + v(z+\Delta z,t) - v(z,t)
\]

Dividing these equations by \( \Delta z \) and taking the limit as \( \Delta z \to 0 \), we get in place of (1.2):

\[
\frac{\partial v(z,t)}{\partial z} = -(l + 2m) \frac{\partial i(z,t)}{\partial t}
\]

\[
\frac{\partial i(z,t)}{\partial z} = -c \frac{\partial v(z,t)}{\partial t}
\]

which is equivalent to the telegrapher’s equations for an ordinary transmission line if we replace the series inductance \( l \) per unit length with the equivalent inductance \( l_{eq} = l + 2m \).