Averages around and including each point in a matrix X:

$$A = (M(MX)^T)^T \oslash D$$

Where $\oslash$ is piece-wise division. A, X are n by n matrices.

M is an n by n matrix $= \begin{bmatrix} 1 & 1 & 0 & 0 & 0 & 0 & ... \\ 1 & 1 & 1 & 0 & 0 & 0 & ... \\ 0 & 1 & 1 & 1 & 0 & 0 & ... \\ 0 & 0 & 1 & 1 & 1 & 0 & ... \\ ... & ... & ... & ... & ... & ... & ... \\ ... & 0 & 0 & 0 & 0 & 1 & 1 \end{bmatrix}$

D is an n by n matrix $= \begin{bmatrix} 4 & 6 & ... & 6 & 4 \\ 6 & 9 & ... & 9 & 6 \\ ... & ... & ... & ... & ... \\ 6 & 9 & ... & 9 & 6 \\ 4 & 6 & ... & 6 & 4 \end{bmatrix}$

Without the piece-wise division by D you have the sums around (and including) each point.
If you only want the sums around the point (not including):

$$A = (M(MX)^T)^T - X$$

For the averages you can do piece-wise division by D with every element by one:

$$A = ((M(MX)^T)^T - X) \oslash (D - O)$$

Where O is the n by n matrix consisting only of 1's.

Example:

$$X = \begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \end{bmatrix}$$

$$M = \begin{bmatrix} 1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 \end{bmatrix}$$

$$D = \begin{bmatrix} 4 & 6 & 6 & 4 \\ 6 & 9 & 9 & 6 \\ 6 & 9 & 9 & 6 \\ 4 & 6 & 6 & 4 \end{bmatrix}$$

$$S = (M(MX)^T)^T = \begin{bmatrix} 2 & 3 & 3 & 2 \\ 3 & 5 & 4 & 3 \\ 3 & 4 & 5 & 3 \\ 2 & 3 & 3 & 2 \end{bmatrix}$$

$$A = S \oslash D = \begin{bmatrix} \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{5}{9} & \frac{4}{9} & \frac{1}{2} \\ \frac{1}{2} & \frac{4}{9} & \frac{5}{9} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \end{bmatrix}$$