The Squeeze-and-Excitation (SE) block operates in two main phases: Squeeze and Excitation. The overall formula can be divided into parts representing these two phases.

### Squeeze Phase

The squeeze phase involves global average pooling across spatial dimensions \(H \times W\) (height and width) of the input feature map \(U\) with \(C\) channels. For each channel \(c\), the global spatial information is squeezed into a single value, producing a channel descriptor. The squeezing operation for a channel \(c\) is given by:

where \(u\_c(i, j)\) is the value of the feature map \(U\) at channel \(c\) and spatial location \((i, j)\), and \(z\_c\) is the squeezed value for channel \(c\).

### Excitation Phase

The excitation phase learns to use the squeezed information \(z\) to recalibrate the feature maps by capturing channel-wise dependencies. This is done through a simple gating mechanism with two fully connected (FC) layers and a sigmoid activation. The recalibration operation for each channel \(c\) is defined as:

- \(g(\cdot)\) represents the transformation function, which includes two FC layers where \(\mathbf{W}\_1\) is the reduction layer (dimensionality-reduction with reduction ratio \(r\), e.g., \(C/r\)), \(\mathbf{W}\_2\) is the dimensionality-increasing layer (mapping it back to the original channel dimension \(C\)), and \(\delta(\cdot)\) denotes the ReLU activation function.

- \(\sigma(\cdot)\) represents the sigmoid activation function that outputs channel-wise weights \(s\_c\) in the range \(0\) to \(1\).

### Final Recalibrated Output

The final output of the SE block, \(\widetilde{X}\_c\), is obtained by rescaling the original input feature maps \(U\) with the activations \(s\_c\), channel-wise:

\[ \widetilde{x}\_c = s\_c \cdot u\_c \]

where \(\cdot\) denotes channel-wise multiplication.

This formula captures the essence of the SE block's operation, emphasizing the importance of specific channels based on the learned global information, thereby enhancing the representational capacity of the network.