Minimum Acquisition Time Calculation for 2D/3D Acquisition Methods

I. 2D Imaging

We use a frequency encoding in one direction and phase encoding in the other.

- Imaging Parameters:
  - N_{RO} (N_x): Frequency encoding (readout) matrix size
  - N_{PE} (N_y): Phase encoding matrix size
  - TR: Repetition time
  - TE: Echo time
  - NEX: Number of excitations (number of averages)

The acquisition time (T_{acq}) is given by:

$$\boxed{T_{Acq} = NEX \cdot N_{PE} \cdot TR} \quad (1)$$

II. 3D Imaging

For 3D imaging, we have to use one of two methods:

1. Multislice acquisition (multiple 2D slices)
2. 3D Fourier imaging (using phase encoding along the slice direction)

- Imaging Parameters:
  - N_{RO} (N_x): Frequency encoding (readout) matrix size
  - N_y: In-plane phase encoding matrix size
  - N_z: Number of slices
  - TR: Repetition time
  - TE: Echo time
  - NEX: Number of excitations (number of averages)

$$\boxed{T_{Acq}(\text{Multislice}) = NEX \cdot N_y \cdot TR \cdot \mathbf{ceiling}\left(\frac{N_z}{\mathbf{floor}(TR/TE)}\right)} \quad (2)$$

$$\boxed{T_{Acq}(3\text{D}) = NEX \cdot N_y \cdot N_z \cdot TR} \quad (3)$$

Notes:

1. **floor**: next integer below, **ceiling**: next integer above.
Ex.: **floor**(1.7)= 1.0, **ceiling** (1.1)= 2.0.

2. Since the readout direction is "for free", select the largest matrix dimension to be along this direction. You have the flexibility (and the duty!) to assign the encoding directions as you prefer to minimize the acquisition time.