The MEAN COUNT MODULATION background model

Assuming detector background can be modelled, for each energy bin, as a detector modulated function of the type $\beta_{\mathbf{d}} \mathbf{B_p}$ of some pointing variable background rate the coded mask response model can be written as

$$\mathbf{C_{d,g,p}} \;=\; \sum_{\mathbf{s}} \mathbf{M_{d,g,p,s}}\; \alpha_{\mathbf{s}} \;+\; \mathbf{B_p}\; \beta_{\mathbf{d,g}} \tag{1}$$

Where

- $\mathbf{C_{d,g,p}}$ are counts in detector (d) of group (g) for pointing (p)
- $\mathbf{M_{d,g,p,s}}$ is the IRF detector pattern for source-no (s).
- $\alpha_{\mathbf{s}}$ is the flux spectrum for source-no (s)
- $\mathbf{B_p}$ is the mean detector background count in pointing (p).
- $\beta_{\mathbf{d,g}}$ is the detector modulation pattern for group (g).

The mean value equation for each detector group (g) and pointing (p) is then

$$\overline{\mathbf{C}}_{\mathbf{g,p}} \;=\; \sum_{\mathbf{s}} \overline{\mathbf{M}}_{\mathbf{g,p,s}}\; \alpha_{\mathbf{s}} \;+\; \mathbf{B_p}\; \overline{\beta_{\mathbf{g}}} \tag{2}$$

Multiplying (2) by $\mu_{\mathbf{d,g}} = \beta_{\mathbf{d,g}} / \overline{\beta_{\mathbf{g}}}$ and subtracting from equation (1) gives the **MEAN COUNT MODULATION** background model equation

$$\mathbf{C_{d,g,p}} - \mu_{\mathbf{d,g}}\; \overline{\mathbf{C}}_{\mathbf{g,p}} \;=\; \sum_{\mathbf{s}} \left[\mathbf{M_{d,g,p,s}} - \mu_{\mathbf{d,g}}\; \overline{\mathbf{M}}_{\mathbf{g,p,s}}\right] \alpha_{\mathbf{s}} \tag{4}$$

or

$$\mathbf{C_{d,g,p}} - \frac{\beta_{\mathbf{d,g}}}{\frac{\mathbf{1}}{\mathbf{D_g}} \sum_{\mathbf{d}} \beta_{\mathbf{d,g}}}\; \overline{\mathbf{C}}_{\mathbf{g,p}} \;=\; \sum_{\mathbf{s}} \left[\mathbf{M_{d,g,p,s}} - \frac{\beta_{\mathbf{d,g}}}{\frac{\mathbf{1}}{\mathbf{D_g}} \sum_{\mathbf{d}} \beta_{\mathbf{d.g}}}\; \overline{\mathbf{M}}_{\mathbf{g,p,s}}\right] \alpha_{\mathbf{s}} \tag{3}$$

or

$$\mathbf{c_{d,g,p}}(\beta_{\mathbf{d,g}}) \;=\; \sum_{\mathbf{s}} \mathbf{m_{d,g,p,s}}(\beta_{\mathbf{d,g}})\; \alpha_{\mathbf{s}} \tag{5}$$

where

- $\mathbf{c_{d,g,p}}$ is the count **fluctuation** pattern around its modulated pointing mean.
- $\mathbf{m_{d,g,p,s}}$ is the IRF **fluctuation** pattern around its modulated pointing mean.
- $\mu_{\mathbf{d,g}}$ is the **normalized** detector modulation pattern for group (g).

The mean background and source flux values are then subsumed under $\mu_{\mathbf{d,g}} \overline{\mathbf{C}}_{\mathbf{g,p}}$ and (5) is to be solved **iteratively** for a $\beta_{\mathbf{d,g}}$ detector modulation pattern and source flux values $\alpha_{\mathbf{s}}$ for each count energy bin.

Detector groups are currently $[\mathbf{0}-\mathbf{18}][\mathbf{19}-\mathbf{60}][\mathbf{61}-\mathbf{84}][\mathbf{85}-\mathbf{141}]$.