1

$1,2$

$R$

$T$

$reso(resampled)/reso(input)$

$t \times f_{\mathrm{res}} / T_{\mathrm{sys}}^2$

$t$

$f_{\mathrm{res}}$



$1/\sigma^2$

$\sigma$

$S$

$(N-1)^{th}$

$N^{th}$

$r_R$

$r_T$

$$r_S = \max(|r_R|, |r_T|)$$

$x_{\min,S}$

$\min(x_{\min,R}, x_{\min,T})$



$\max(x_{\max,R}, x_{\max,T})$

$\max(x_{\min,R}, x_{\min,T})$

$\min(x_{\max,R}, x_{\max,T})$

$N$

$$N_S = \mathrm{int}(\frac{x_{\max,S} - x_{\min,S}}{r_S} + 1.5),$$

$$x_{\mathrm{val},S} = x_{\mathrm{min},S} - 1. \times r_S,$$

$x_{\min,S}$

$x$

$$\left[x_{\min,S}, x_{\max,S}\right]$$

$N_S$

$T(i)$

$w(i)$

Averaged channel intensity and weight (aligned spectra):

$$T_S(i) = \frac{w_R(i) \times T_R(i) + w_T(i) \times T_T(i)}{w_R(i) + w_T(i)} \quad (1)$$

$$w_S(i) = w_R(i) + w_T(i) \quad (2)$$

$R'$

$T'$



$k_{\min}$





$T_R$

$i$

$N(\mu_R, {\sigma_R}^2)$

$$\mathrm{pdf}_R(x) = \frac{1}{\sigma_R \sqrt{2\pi}} \exp\left(-\frac{(x-\mu_R)^2}{2{\sigma_R}^2}\right)$$

$\mu_R$

$\sigma_R$

$$\mathrm{var}(T_R(i)) = \sigma_R(i)^2$$

$w_R(i)$

$$w_R(i) = \frac{1}{\sigma_R(i)^2}$$

Resampled channel intensity (all weights):

$$T_{R'}(i) = \frac{\sum_{j=j_{\min}}^{j_{\max}} f_R(j) \times w_R(j) \times T_R(j)}{\sum_{j=j_{\min}}^{j_{\max}} f_R(j) \times w_R(j)} \tag{3}$$



$$f(j) = 0$$

$$f(j) = 1$$

$0 < f(j) < 1$



$$\beta = \sum_{j=j_{\min}}^{j_{\max}} f_R(j) \times w_R(j)$$

$$\alpha_R(j) = \frac{f_R(j) \times w_R(j)}{\beta}$$



$$T_{R'}(i) = \sum_{j=j_{\min}}^{j_{\max}} \alpha_R(j) \times T_R(j)$$

$\mathrm{var}(T_{R'}(i))$

$$\mathrm{var}\left(\sum_{j=j_{\min}}^{j_{\max}} \alpha_R(j) \times T_R(j)\right)$$

$$\sum_{j=j_{\min}}^{j_{\max}} \alpha_R(j)^2 \times \operatorname{var}\left(T_R(j)\right)$$

$$\frac{1}{\beta^2} \sum_{j=j_{\min}}^{j_{\max}} f_R(j)^2 \, w_R(j)$$

$$\mathrm{var}(aX + bY) = a^2\mathrm{var}(X) + b^2\mathrm{var}(Y)$$

$a$

$b$

$X$

$Y$

Resampled channel weight (weights `TIME` and SIGMA):

$$w_{R'}(i) = \frac{\left(\sum_{j=j_{\min}}^{j_{\max}} f_R(j) w_R(j)\right)^2}{\sum_{j=j_{\min}}^{j_{\max}} f_R(j)^2 \, w_R(j)} \tag{4}$$

$R'$



$0.25$





$w_{R'}$

$\sigma_{R'}$

$x_{\mathrm{val}} \to x_{\mathrm{val}} + 0.00$

$$w_{R'} = w_R$$

$\sigma_{R'} = \sigma_R$

$x_{\mathrm{val}} \rightarrow x_{\mathrm{val}} + 0.25$

$$w_{R'} = 1.6 \times w_R$$

$$\sigma_{R'} = \sigma_R / \sqrt{1.6}$$

$x_{\mathrm{val}} \to x_{\mathrm{val}} + 0.50$

$$w_{R'} = 2 \times w_R$$

$$\sigma_{R'} = \sigma_R / \sqrt{2}$$

$\sqrt{2}$

$R' \to R''$

Resampled channel weight (weight `EQUAL`):

$$w_{R'}(i) = \frac{\sum_{j=j_{\min}}^{j_{\max}} f_R(j) w_R(j)}{\sum_{j=j_{\min}}^{j_{\max}} f_R(j)} \tag{5}$$

$1.0$

$T_S$

$w_S$

Averaged channel intensity and weight (non-aligned spectra):

$$T_S(i) = \frac{w_{R'}(i) \times T_{R'}(i) + w_{T'}(i) \times T_{T'}(i)}{w_{R'}(i) + w_{T'}(i)} \quad (6)$$

$$w_S(i) = w_{R'}(i) + w_{T'}(i) \quad (7)$$

$f \neq 0$

"





$$t_{S_{\text{out}}} = t_{S_{\text{in}}} + t_{\text{obs}}$$



$t \times |r|/T_{\mathrm{sys}}^2$

$\gamma$

$$\frac{t_{S_{\text{out}}} \times |r_{S_{\text{out}}}|}{T^2_{\text{sys},S_{\text{out}}}} = \frac{t_{S_{\text{in}}} \times |r_{S_{\text{in}}}|}{T^2_{\text{sys},S_{\text{in}}}} + \frac{t_{\text{obs}} \times |r_{\text{obs}}|}{T^2_{\text{sys,obs}}}$$







$$(f_{\mathrm{off},S_{\mathrm{out}}} - x_{\mathrm{val},S_{\mathrm{out}}})/f_{\mathrm{res},S_{\mathrm{out}}}$$

$$f(i_{\text{chan}}) = f_{\text{res}} \times (i_{\text{chan}} - r_{\text{chan}}) + f_{\text{off}}$$

$i_{\text{chan}} = 0$

$$x_{\mathrm{val}} = f_{\mathrm{res}} \times (0 - r_{\mathrm{chan}}) + f_{\mathrm{off}}$$



$$-c \times f_{\mathrm{res},S_{\mathrm{out}}} / f_{\mathrm{rest},S_{\mathrm{out}}}$$

$c$


$v_{\text{off}}, S_{\text{out}}$


$v_{\text{off}}, S_{\text{in}}$



$$\left(v_{\mathrm{off},S_{\mathrm{out}}} - x_{\mathrm{val},S_{\mathrm{out}}}\right)/v_{\mathrm{res},S_{\mathrm{out}}}$$

$-f_{\mathrm{rest},S_{\mathrm{out}}} \times v_{\mathrm{res},S_{\mathrm{out}}}/c$