

Frequency domain features

N.	Name	Formula
1	Mean Frequency	$F1 = \frac{\sum_{k=1}^K X(k)}{K}$
2	Variancef	$F2 = \frac{\sum_{k=1}^K (X(k)-F1)^2}{K-1}$
3	Skewnessf	$F3 = \frac{\sum_{k=1}^K (X(k)-F1)^3}{(X(k)-F1)^3} K(\sqrt{Varf})^3$
4	Kurtosisf	$F4 = \frac{\sum_{k=1}^K (X(k)-F1)^4}{K(Varf)^4}$
5	Central Frequency	$F5 = \frac{\sum_{k=1}^K f_k X(k)}{\sum_{k=1}^K X(k)}$
6	STDF	$F6 = \sqrt{\frac{\sum_{k=1}^K (f_k - FC)^2 X(k)}{(\sum_{k=1}^K X(k))}}$
7	RMSF	$F7 = \sqrt{\frac{\sum_{k=1}^K f_k^2 X(k)}{\sum_{k=1}^K X(k)}}$
8	CP1	$F8 = \frac{\sum_{k=1}^K (f_k - FC)^3 X(k)}{K(STDF)^3}$
9	CP2	$F9 = \frac{STDF}{FC}$
10	CP3	$F10 = \frac{\sum_{k=1}^K (f_k - FC)^{\frac{1}{2}} X(k)}{K\sqrt{STDF}}$
11	CP4	$F11 = \frac{\sum_{k=1}^K (f_k - FC)^3 X(k)}{STDF^2 K}$
12	CP5	$F12 = \sqrt{\frac{\sum_{k=1}^K f_k^4 X(k)}{\sum_{k=1}^K f_k^2 X(k)}}$
13	Total power	$F13 = \sum_{k=1}^M P(k) = SMO$
14	Median Frequency	$F14 = \sum_{k=1}^{MDF} P(k) = \sum_{k=MDF}^M P(k) = \frac{1}{2} \sum_{k=1}^M P(k)$
15	Peak frequency	$F15 = \max(P(k)), \quad k = 1, \dots, M.$
16	First Spectral Moment	$F16 = \sum_{k=1}^M P(k) f_k$
17	Second Spectral	$F17 = \sum_{k=1}^M P(k) f_k^2$
18	Third Spectral Moment	$F18 = \sum_{k=1}^M P(k) f_k^3$
19	Fourth Spectral Moment	$F19 = \sum_{k=1}^M P(k) f_k^4$
20	Variance of central frequency(VCF)	$F20 = \frac{1}{SM0} \sum_{k=1}^M P(k) (f_k - f_c)^2 = \frac{SM2}{SM0} - (\frac{SM1}{SM0})^2$
21	Frequency ratio (FR)	$F21 = \sum_{LLC=f_{min}}^{ULC=f_{max}/2} P(k) / \sum_{LHC=f_{max}}^{UHC=f_{max}} P(k)$ Where $f_{min} = 5$ and $f_{max} = 3000$ as default study frequency

22	Spectral Centroid	$F22 = \frac{\sum_{k=1}^K kX(k)}{\sum_{k=1}^K X(k)}$
23	Spectral Spread	$F23 = \sqrt{\frac{\sum_{k=1}^K (k-SC)^2 X(k)}{\sum_{k=1}^K X(k)}}$
24	Spectral Entropy	$F24 = -\sum_{k=1}^{K-1} P_n(k) \log_2[P_n(k)]$ where P_n is the normalized total spectral energy

Table 1: Frequency domain indicators