Important Discrete Time Signals Formulas PDF

Formulas
Examples
with Units

List of 14
Important Discrete Time Signals Formulas

1) Bilinear Transformation Frequency Formula

Evaluate Formula

Formula

$$f_b = \frac{2 \cdot \pi \cdot f_c}{\tan\left(\pi \cdot \frac{f_c}{f_e}\right)}$$

Example with Units

$$76.8194\,\text{Hz} = \frac{2 \cdot 3.1416 \cdot 4.52\,\text{Hz}}{\tan\left(3.1416 \cdot \frac{4.52\,\text{Hz}}{40.1\,\text{Hz}}\right)}$$

2) Cutoff Angular Frequency Formula

Evaluate Formula

Formula

$$\omega_{co} = \frac{M \cdot f_{ce}}{W_{ss} \cdot K}$$

Example with Units

$$0.96\,\text{rad/s} = \frac{8 \cdot 2.52\,\text{Hz}}{7 \cdot 3\,\text{s}}$$

3) Damping Coefficient of Second Order Transmittance Formula

Evaluate Formula

Formula

$$\zeta_o = \left(\frac{1}{2}\right) \cdot R_{in} \cdot C_{in} \cdot \sqrt{\frac{K_f \cdot L_o}{W_{ss} \cdot C_{in}}}$$

Example with Units

$$2.8969\,\text{Ns/m} = \left(\frac{1}{2}\right) \cdot 4.51\,\Omega \cdot 3.8\,\text{F} \cdot \sqrt{\frac{0.76 \cdot 4\,\text{H}}{7 \cdot 3.8\,\text{F}}}$$

4) Fourier Transform of Rectangular Window Formula

Evaluate Formula

Formula

$$W_{rn} = \frac{\sin\left(2 \cdot \pi \cdot T_o \cdot f_{inp}\right)}{\pi \cdot f_{inp}}$$

Example with Units

$$0.0373 = \frac{\sin\left(2 \cdot 3.1416 \cdot 40 \cdot 5.01\,\text{Hz}\right)}{3.1416 \cdot 5.01\,\text{Hz}}$$

5) Frequency Dirac Comb Angle Formula

Evaluate Formula

Formula

$$\theta = 2 \cdot \pi \cdot f_{inp} \cdot \frac{1}{f_o}$$

Example with Units

$$0.6296\,\text{rad} = 2 \cdot 3.1416 \cdot 5.01\,\text{Hz} \cdot \frac{1}{50\,\text{Hz}}$$

6) Hamming Window Formula

Evaluate Formula

Formula

$$W_{hm} = 0.54 - 0.46 \cdot \cos\left(\frac{2 \cdot \pi \cdot n}{W_{ss} - 1}\right)$$

Example

$$0.8143 = 0.54 - 0.46 \cdot \cos\left(\frac{2 \cdot 3.1416 \cdot 2.11}{7 - 1}\right)$$

7) Hanning Window Formula

Evaluate Formula

Formula

$$W_{hn} = \frac{1}{2} - \left(\frac{1}{2}\right) \cdot \cos\left(\frac{2 \cdot \pi \cdot n}{W_{ss} - 1}\right)$$

Example

$$0.7981 = \frac{1}{2} - \left(\frac{1}{2}\right) \cdot \cos\left(\frac{2 \cdot 3.1416 \cdot 2.11}{7 - 1}\right)$$

8) Initial Frequency of Dirac Comb Angle Formula

Evaluate Formula

Formula

$$f_o = \frac{2 \cdot \pi \cdot f_{inp}}{\theta}$$

Example with Units

$$50.7722\,\text{Hz} = \frac{2 \cdot 3.1416 \cdot 5.01\,\text{Hz}}{0.62\,\text{rad}}$$

9) Inverse Transmittance Filtering Formula

Evaluate Formula

Formula

$$K_n = \left(\text{sinc}\left(\pi \cdot \frac{f_{inp}}{f_e}\right)\right)^{-1}$$

Example with Units

$$1.3069 = \left(\text{sinc}\left(3.1416 \cdot \frac{5.01\,\text{Hz}}{40.1\,\text{Hz}}\right)\right)^{-1}$$

10) Maximal Variation of Cutoff Angular Frequency Formula

Evaluate Formula

Formula

$$M = \frac{\omega_{co} \cdot W_{ss} \cdot K}{f_{ce}}$$

Example with Units

$$8 = \frac{0.96\,\text{rad/s} \cdot 7 \cdot 3\,\text{s}}{2.52\,\text{Hz}}$$

11) Natural Angular Frequency of Second Order Transmittance Formula

Evaluate Formula

Formula

$$\omega_n = \sqrt{\frac{K_f \cdot L_o}{W_{ss} \cdot C_{in}}}$$

Example with Units

$$0.3381\,\text{rad/s} = \sqrt{\frac{0.76 \cdot 4\,\text{H}}{7 \cdot 3.8\,\text{F}}}$$

12) Sampling Frequency of Bilinear Formula

Evaluate Formula

Formula

$$f_e = \frac{\pi \cdot f_c}{\arctan\left(\frac{2 \cdot \pi \cdot f_c}{f_b}\right)}$$

Example with Units

$$40.0955\,\text{Hz} = \frac{3.1416 \cdot 4.52\,\text{Hz}}{\arctan\left(\frac{2 \cdot 3.1416 \cdot 4.52\,\text{Hz}}{76.81\,\text{Hz}}\right)}$$

13) Transmittance Filtering Formula

Evaluate Formula

Formula

$$K_f = \text{sinc}\left(\pi \cdot \left(\frac{f_{inp}}{f_e}\right)\right)$$

Example with Units

$$0.7652 = \text{sinc}\left(3.1416 \cdot \left(\frac{5.01\,\text{Hz}}{40.1\,\text{Hz}}\right)\right)$$

14) Triangular Window Formula

Evaluate Formula

Formula

$$W_{tn} = 0.42 - 0.52 \cdot \cos\left(\frac{2 \cdot \pi \cdot n}{W_{ss} - 1}\right) - 0.08 \cdot \cos\left(\frac{4 \cdot \pi \cdot n}{W_{ss} - 1}\right)$$

Example

$$0.7532 = 0.42 - 0.52 \cdot \cos\left(\frac{2 \cdot 3.1416 \cdot 2.11}{7 - 1}\right) - 0.08 \cdot \cos\left(\frac{4 \cdot 3.1416 \cdot 2.11}{7 - 1}\right)$$

Variables used in list of Discrete Time Signals Formulas above

- C_{in} Initial Capacitance *(Farad)*
- f_b Bilinear Frequency *(Hertz)*
- f_c Distortion Frequency *(Hertz)*
- f_{ce} Central Frequency *(Hertz)*
- f_e Sampling Frequency *(Hertz)*
- f_{inp} Input Periodic Frequency *(Hertz)*
- f_o Initial Frequency *(Hertz)*
- **K** Clock Count *(Second)*
- K_f Transmittance Filtering
- K_n Inverse Transmittance Filtering
- L_o Input Inductance *(Henry)*
- **M** Maximal Variation
- **n** Number of Samples
- R_{in} Input Resistance *(Ohm)*
- T_o Unlimited Time Signal
- W_{hm} Hamming Window
- W_{hn} Hanning Window
- W_{rn} Rectangular Window
- W_{ss} Sample Signal Window
- W_{tn} Triangular Window
- ζ_o Damping Coefficient *(Newton Second per Meter)*
- θ Signal Angle *(Radian)*
- ω_{co} Cutoff Angular Frequency *(Radian per Second)*
- ω_n Natural Angular Frequency *(Radian per Second)*

Constants, Functions, Measurements used in list of Discrete Time Signals Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **arctan**, arctan(Number) *Inverse trigonometric functions are usually accompanied by the prefix - arc. Mathematically, we represent arctan or the inverse tangent function as tan-1 x or arctan(x).*
- Functions: **cos**, cos(Angle) *Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.*
- Functions: **ctan**, ctan(Angle) *Cotangent is a trigonometric function that is defined as the ratio of the adjacent side to the opposite side in a right triangle.*
- Functions: **sin**, sin(Angle) *Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.*
- Functions: **sinc**, sinc(Number) *The sinc function is a function that is frequently used in signal processing and the theory of Fourier transforms.*
- Functions: **sqrt**, sqrt(Number) *A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.*
- Functions: **tan**, tan(Angle) *The tangent of an angle is a trigonometric ratio of the length of the side opposite an angle to the length of the side adjacent to an angle in a right triangle.*
- Measurement: **Time** in Second (s) *Time Unit Conversion*
- Measurement: **Angle** in Radian (rad) *Angle Unit Conversion*
- Measurement: **Frequency** in Hertz (Hz) *Frequency Unit Conversion*
- Measurement: **Capacitance** in Farad (F) *Capacitance Unit Conversion*

- Measurement: **Electric Resistance** in Ohm (Ω)
  Electric Resistance Unit Conversion
- Measurement: **Inductance** in Henry (H)
  Inductance Unit Conversion
- Measurement: **Damping Coefficient** in Newton Second per Meter (Ns/m)
  Damping Coefficient Unit Conversion
- Measurement: **Angular Frequency** in Radian per Second (rad/s)
  Angular Frequency Unit Conversion

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