Important Basics of Image Processing Formulas PDF

Formulas
Examples
with Units

List of 17
Important Basics of Image Processing Formulas

1) Band Loads Associated with Principle Components Formula

Evaluate Formula

Formula

$$R_{kp} = a_{kp} \cdot \frac{\sqrt{\lambda_p}}{\sqrt{Var_k}}$$

Example

$$0.9682 = 0.75 \cdot \frac{\sqrt{5}}{\sqrt{3}}$$

2) Bilinear Interpolation Formula

Evaluate Formula

Formula

$$V_{x,y} = A \cdot X + B \cdot Y + C \cdot X \cdot Y + D$$

Example

$$207.85 = 3.5 \cdot 7 + 1.15 \cdot 6 + 4.15 \cdot 7 \cdot 6 + 2.15$$

3) Cumulative Frequency for Each Brightness Value Formula

Evaluate Formula

Formula

$$K_i = \frac{1}{n} \cdot \sum \left(x, 0, N_{max}, f[BV_i] \right)$$

Example with Units

$$36 = \frac{1}{40\,\text{px}} \cdot \sum \left(x, 0, 17.48\,\text{W/m}^2, 80 \right)$$

4) Digital Image Column Formula

Evaluate Formula

Formula

$$N = \frac{n_b}{M^2}$$

Example

$$0.0617 = \frac{5}{9^2}$$

5) Digital Image Row Formula

Evaluate Formula

Formula

$$M = \sqrt{\frac{n_b}{N}}$$

Example

$$9.0536 = \sqrt{\frac{5}{0.061}}$$

6) Digital to Analog Converter Formula

Evaluate Formula

Formula

$$V_r = \frac{V}{2^{n_b} - 1}$$

Example with Units

$$6.0968\,\text{V} = \frac{189\,\text{V}}{2^5 - 1}$$

7) Energy of Various Components Formula

Evaluate Formula

Formula

$$E = [hP] \cdot f$$

Example with Units

$$0.4136\,\text{eV} = 6.6\text{E-}34 \cdot 100\,\text{THz}$$

8) Image File Size Formula

Evaluate Formula

Formula

$$S_i = R_i \cdot \frac{B_d}{8000}$$

Example with Units

$$4.25\,\text{bits} = 1000\,\text{px} \cdot \frac{34\,\text{bits}}{8000}$$

9) Linear Combination of Expansion Formula

Evaluate Formula

Formula

$$f[x] = \sum\left(x, 0, k, \alpha_k \cdot \varphi[x]\right)$$

Example

$$50 = \sum\left(x, 0, 4, 2 \cdot 5\right)$$

10) Number of Bits Formula

Evaluate Formula

Formula

$$n_b = \left(M^2\right) \cdot N$$

Example

$$4.941 = \left(9^2\right) \cdot 0.061$$

11) Number of Grey Level Formula

Evaluate Formula

Formula

$$L = 2^N$$

Example

$$1.0432 = 2^{0.061}$$

12) Probability of Intensity Level Occurring in given Image Formula

Evaluate Formula

Formula

$$P_{ZK} = \frac{N_k}{n}$$

Example with Units

$$0.075 = \frac{3}{40\,\text{px}}$$

13) Quantization Step Size in Image Processing Formula

Evaluate Formula

Formula

$$\Delta_b = \left(2^{R_b - \varepsilon_b}\right) \cdot \left(1 + \frac{\mu_b}{2^{11}}\right)$$

Example with Units

$$443.1024\,\text{kW/m}^2 = \left(2^{21\,\text{dB} - 2.245}\right) \cdot \left(1 + \frac{3.24}{2^{11}}\right)$$

14) Rejection of Image Frequency Formula

Evaluate Formula

Formula

$$CSP = \left(1 + Q^2 \cdot \rho^2\right)^{0.5}$$

Example

$$300.0017 = \left(1 + 20^2 \cdot 15^2\right)^{0.5}$$

15) Run-Length Entropy of Image Formula

Evaluate Formula

Formula

$$H_{RL} = \frac{H_0 + H_1}{L_0 + L_1}$$

Example with Units

$$0.0443\,\text{J/K} = \frac{0.25\,\text{J/K} + 2.45\,\text{J/K}}{30\,\text{px} + 31\,\text{px}}$$

16) Standard Deviation by Linear Function of Camera Exposure Time Formula

Evaluate Formula

Formula

$$\Sigma = \zeta \cdot \left(I_p \right) \cdot \delta \cdot \left(\frac{1}{d^2} \right) \cdot \left(\tau_1 \cdot t + \tau_2 \right)$$

Example with Units

$$87.0966 = 1.75 \cdot \left(2.45\,\text{mA} \right) \cdot 6 \cdot \left(\frac{1}{2.85\,\text{cm}^2} \right) \cdot \left(3.15 \cdot 6\,\mu\text{s} + 2.75 \right)$$

17) Wavelet Coefficient Formula

Evaluate Formula

Formula

$$d_j[k] = \int \left(f_s[x] \cdot \psi_{j,k}[x] \cdot x, x, 0, k \right)$$

Example

$$160 = \int \left(2.5 \cdot 8 \cdot x, x, 0, 4 \right)$$

Variables used in list of Basics of Image Processing Formulas above

- **A** Coefficient a
- a_{kp} Eigen Band k Component P
- **B** Coefficient b
- B_d Bit Depth *(Bit)*
- **C** Coefficient c
- **CSP** Customer Selling Price
- **d** Distance between Camera and the IRED *(Centimeter)*
- **D** Coefficient d
- $d_j[k]$ Detail Wavelet Coefficient
- **E** Energy of Component *(Electron-Volt)*
- **f** Frequency *(Terahertz)*
- $f_s[x]$ Scaling Function Expansion
- $f[BV_i]$ Frequency of Occurrence of Each Brightness Value
- **f[x]** Linear Combination of Expansion Functions
- H_0 Entropy Black Run Length *(Joule per Kelvin)*
- H_1 Entropy of White Run Length *(Joule per Kelvin)*
- H_{RL} Run Length Entropy Image *(Joule per Kelvin)*
- I_p Radiant Intensity *(Milliampere)*
- **k** Integer Index for Linear Expansion
- K_i Cumulative Frequency for Each Brightness
- **L** Grey Level Image
- L_0 Average Black Run Length *(Pixel)*
- L_1 Average White Run Length *(Pixel)*
- **M** Digital Image Row
- **n** Total Number of Pixels *(Pixel)*
- **N** Digital Image Column
- n_b Number of Bits
- N_k Intensity Occurs in Image
- N_{max} Maximum Brightness Value *(Watt per Square Meter)*

Constants, Functions, Measurements used in list of Basics of Image Processing Formulas above

- constant(s): **[hP]**, 6.626070040E-34
  Planck constant
- Functions: **int**, int(expr, arg, from, to)
  The definite integral can be used to calculate net signed area, which is the area above the x -axis minus the area below the x -axis.
- 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: **sum**, sum(i, from, to, expr)
  Summation or sigma (∑) notation is a method used to write out a long sum in a concise way.
- Measurement: **Length** in Centimeter (cm)
  Length Unit Conversion
- Measurement: **Time** in Microsecond (µs)
  Time Unit Conversion
- Measurement: **Electric Current** in Milliampere (mA)
  Electric Current Unit Conversion
- Measurement: **Energy** in Electron-Volt (eV)
  Energy Unit Conversion
- Measurement: **Frequency** in Terahertz (THz)
  Frequency Unit Conversion
- Measurement: **Data Storage** in Bit (bits)
  Data Storage Unit Conversion
- Measurement: **Electric Potential** in Volt (V)
  Electric Potential Unit Conversion
- Measurement: **Sound** in Decibel (dB)
  Sound Unit Conversion
- Measurement: **Resolution** in Pixel (px)
  Resolution Unit Conversion
- Measurement: **Entropy** in Joule per Kelvin (J/K)
  Entropy Unit Conversion
- Measurement: **Intensity** in Watt per Square Meter (W/m²), Kilowatt per Square Meter (kW/m²)
  Intensity Unit Conversion

- P_{ZK} Probability of Intensity
- Q Quality Factor Image
- R_b Nominal Dynamic Range *(Decibel)*
- R_i Image Resolution *(Pixel)*
- R_{kp} K Band Loads with P Principle Components
- S_i Image File Size *(Bit)*
- t Camera Exposure Time *(Microsecond)*
- V Reference Voltage Image *(Volt)*
- V_r Digital to Analog Converter Resolution *(Volt)*
- $V_{x,y}$ Bilinear Interpolation
- Var_k Band Variance Matrix
- X X Co-ordinate
- Y Y Co-ordinate
- α_k Real Valued Expansion Coefficients
- δ Model Behaviour Function
- Δ_b Quantization Step Size *(Kilowatt per Square Meter)*
- ε_b Bits Allotted Exponent Number
- ζ Model Function
- λ_p Pth Eigenvalue
- μ_b Bits Allotted to Mantissa Number
- ρ Rejection Constant Image
- Σ Standard Deviation
- τ_1 Model Coefficient 1
- τ_2 Model Coefficient 2
- $\varphi[x]$ Real Valued Expansion Functions
- $\Psi_{j,k}[x]$ Wavelet Expansion Function

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