Color Image Processing - Summary Notes

1. Color Models
- RGB: (R, G, B) $\in$ [0,255].
- HSI: Hue (H), Saturation (S), Intensity (I).
I = (R+G+B)/3

2. Power-Law Transformation (Gamma Correction)
f_out = 255 * (f_in / 255)^γ

3. Filters
- Averaging filter (smoothing): g(x,y) = (1/mn) Σ f(x+i, y+j)
- Gaussian filter: g(x,y) = Σ f(x+i,y+j) * exp(-(i²+j²)/(2σ²))

4. Laplacian (Sharpening)
$\nabla^2 f(x,y) = \partial^2 f/\partial x^2 + \partial^2 f/\partial y^2$
Sharpened = f(x,y) - λ∇^2 f(x,y)

5. Segmentation in HSI
- Use Hue for color detection.
- Mask from Saturation > threshold.
- Product: Hue × Mask → Threshold → Binary segmentation.

6. Segmentation in RGB
- Mean vector a = (aR, aG, aB)
- Box limits = a ± 1.25σ (σ = std deviation per channel).
- Pixel $\in$ box → foreground.

7. Edge Detection in RGB
- Vector gradient magnitude:
$|\nabla f| = \sqrt{[(\partial R/\partial x)^2+(\partial R/\partial y)^2+(\partial G/\partial x)^2+(\partial G/\partial y)^2+(\partial B/\partial x)^2+(\partial B/\partial y)^2]}$

8. Noise in Color Images
- Additive Gaussian noise: n(x,y) ~ N(0,σ²).
- Noise spreads in HSI due to nonlinear conversion.

9. Color Image Compression
- Image size = width × height × bits/pixel.
- RGB (24-bit): 8 bits per channel.
- Compression ratio = Original size / Compressed size.
- Lossy compression may blur, lossless keeps exact data.