IQM Approach: Obtain Quality from Image Power Spectrum

\[ \text{IQM} = \frac{1}{M^2} S(q_1) W(r) A^2(T) P(r, q) \]

- \( M^2 \) = digital image size in pixels
- \( S(q_1) \) = directional image scale parameter
- \( W(r) \) = modified Wiener noise filter
- \( A^2(T) \) = MTF of human visual system (T=constant)
- \( P(r, q) \) = brightness normalized image power spectrum
- \( r, q \) = spatial frequency in polar coordinates

1) Normalize PS
2) Weight PS
3) Sum Power

Image Quality Measure

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Attributes of IQM

• Measurement on operational images
  no test targets, no reference images, no prediction

• Rapid, automated, objective

• Correlates with visual quality assessments

• Image degradations detectable / identifiable
  from analysis of power spectrum

• Alternative subjective assessment is:
  variable
  time consuming
  labor intensive ($)

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Applications

Reconnaissance

- Evaluate system performance
- Manage archive of collected imagery
- Set exploitation priorities
- Establish exploitation confidence level

Forensics (Fingerprints)

- Optimize developing systems
- Maintain quality of fingerprint archives
- Operational quality assurance
Applications

Image Compression
Optimize compression via objective, rapid assessment of relative quality

Medical
Indicate quality reduction that may impair radiologist’s tasks and reliability

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Correlation: IQM vs. Visual NIIRS

IQM demonstrates good correlation with visual NIIRS*

 corr.coeff = 0.93

* NIIRS is standard visual quality scale for reconnaissance
Results: Compression and Fingerprints

Compression: IQM tracks quality loss due to compression

Fingerprints: IQM tracks subjective quality assessment

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Image Degradations Detected By Power Spectrum

Spatial frequency increases radially outward from center (dc) of power spectrum.

Blur: slopes e-f, f-g
Noise: g/j
Haze: ac/dc
CCD banding: j/i
Smear from 90° ratio

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More Details

Technical Publication:

"Objective Image Quality Measure Derived from Digital Image Power Spectra”
by N.B. Nill and B.H. Bouzas, April 1992,

Website:
www.mitre.org/tech/mtf