**Performance Analysis of a Hardware Implemented Complex Signal Kurtosis Radio-Frequency Interference Detector**

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### Motivation

- RFI compromises quality of science products.
- Spectrum is becoming crowded and shared.
- Hardware capabilities allow for digital radiometry.
- Need more sensitive detectors for wide-band interference.

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### Complex Signal Kurtosis

Given a complex baseband signal $z(n) = I(n) + jQ(n)$, moments $\alpha_{\ell,m}$ of $z(n)$ are defined as

$$\alpha_{\ell,m} = \mathbb{E}[(z - \mathbb{E}[z])^\ell(z - \mathbb{E}[z])^m], \ell, m \in \mathbb{R} \geq 0$$

With $\sigma^2 = \alpha_{1,1}$, Standardized moments $\varrho_{\ell,m}$ can then be found as

$$\varrho_{\ell,m} = \frac{\alpha_{\ell,m}}{\sigma^{\ell+m}}$$

Leading to the CSK (Complex Signal Kurtosis) rfi test statistic used [1,2].

For Real Signal Kurtosis, the fourth based standardized moment is computed independently for both the real and imaginary vectors, I and Q as was used in SMAP [3].

$$R_{\text{SK}1} = \frac{\mathbb{E}[(Q - \mathbb{E}[Q])^4]}{\mathbb{E}[(I - \mathbb{E}[I])^2]^2} - 3, \quad R_{\text{SK}2} = \frac{\mathbb{E}[(Q - \mathbb{E}[Q])^4]}{\mathbb{E}[(Q - \mathbb{E}[Q])^2]^2} - 3$$

The test statistic, RSK (Real Signal Kurtosis), is then defined as

$$\text{RSK} = \frac{|R_{\text{SK}1}| + |R_{\text{SK}2}|}{2}$$

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### Methodology

**Hardware Results**

**Simulation Results**

### Conclusions

CSK (Complex Signal Kurtosis) provides a better detection rate than real signal kurtosis.

Interference becomes detectable at an INR (Interference to Noise Ratio) of 2dB lower than what can be detected using RSK (Real Signal Kurtosis).

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### References


### Acknowledgments

The research team would like to thank the NASA Earth Science Technology Office NNH13ZDA001NACT program for funding this research.