COMPARING APPROACHES TO SIGNAL CLASSIFICATION & DF

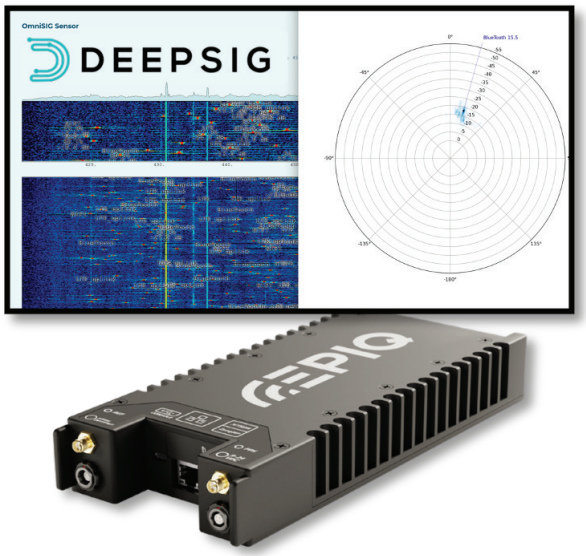
For as long as adversaries have been using the radio frequency spectrum for communications, there has been a desire by the other side to use them for intelligence gathering. Signal acquisition and processing is evolving rapidly with the advent of ever more powerful edge processing and artificial intelligence (AI). This brief overview compares the latest approaches from Epiq and DeepSig to the conventional approaches they are replacing.

	Conventional DSP	Epiq & DeepSig
Speed	Adding a new signal type is expensive and takes months.	Non-engineers can identify, process and deploy a new signal in hours. Removes 90% of the classification effort from the operator.
	Slow scanning. Traditional DSP routines do not scale – 30 min to an hour to process. Typically, might complete RF survey in 3-5 minutes over 6 GHz of RF bandwidth, due to the need to examine each signal individually.	Scans 6 GHz of bandwidth in 12 seconds on common platforms. Wide band "one-look" classification. 10-100x faster than traditional classifiers. Wider bandwidths or slower processors reduce the number of slices per second processed but do not degrade the quality of output.
Signal Types	Need to demodulate a signal to classify it. Can only sift through a small percentage of the enormous amounts of available data.	Recognizes signals based on spectral characteristics. Tips demodulators so that they don't waste time on basic survey, allowing vast amounts of data to be filtered.
	Requires very specific signal features to be present in the samples to be successful.	Can classify even when given only small portions of a signal. Needs slices of only a few milliseconds to produce high quality stream of independent labeled datasets.
	Inconsistent results if they don't receive continuous data.	Operates on discrete samples of only a few milliseconds.
	Static library. Few signal types.	Can be taught and improved rapidly by adding more data – even in the field.
	Struggle with intermittent/ frequency hopping signals.	Will tell you the signal class, the bandwidth, the approximate signal power, and (with OmniSIG DF) the azimuth, all features you can use to create a multidimensional cluster of emitters with spatial information.
	Needs to have seen signals before.	Good at recognizing Unknown signals, often able to provide clues about what type they are similar to. Provides confidence percentage on every one.
Platform	Financially burdensome.	Deployable at the edge in high volume.
	Computationally expensive.	Operates disconnected at the edge. 20-100 MB executable that can be pushed out quickly over low bandwidth links.
	Specific to a platform.	Easy to integrate into SFF systems. LibSideKiq is easy to work with. Same for every Epiq radio model once DeepSig integrated.

	Conventional DF	Epiq & DeepSig DF
System	Separate DF and classification systems.	Same antennas, radio, get both classification and DF. Provides Azimuth (and optionally Elevation) metadata to standard SigMF output.
	Designed for a specific system.	Capable of being trained on a wide variety of antenna types. After a model is calibrated for a specific antenna, Libsidekiq means can easily swap between Epiq radios. Radios are high quality, with very linear front-ends.
Signal Acquisition	Need several seconds of acquisition and averaging to DF a signal. Computationally expensive, effort scales with the number of signals.	Few millisecond snapshot can provide classification and DF. If the software can detect it, it can DF it. Each DF estimate is completely independent, can be aggregated to improve accuracy.
	Good accuracy for the right signals (eventually).	~2° RMS error achievable for reasonably well tuned discrete arrays or Watson-Watt/CDF antennas.
Antenna-Related	Requires equally spaced, regular antenna elements. Difficult for packaging into irregular spaces such as drone payloads.	Optimally leverage regular and chaotic discrete arrays, Watson-Watt/ CDF antennas. Calibration directly from empirical measured data.
	Intolerant of an antenna element being disconnected.	Tolerant of fewer antennas, just gracefully reduces accuracy.
	Performance measurements in unrepresentative anechoic chamber.	Can easily operate in a congested, real-world environment.

Traditional digital signal processing (DSP) based systems can be rigid, hard to update, expensive to develop and maintain and difficult to deploy on small platforms. New approaches are becoming available which combine compact, high performance radios with on-board graphical processing units (GPUs), and AI-enabled signal classification and direction finding (DF) software. Examples include our **new G20, G40 and X40** software defined radios (SDRs) which come with **DeepSig's OmniSIG AI software** pre-loaded. The first table (previous page) examines general signal classification aspects between old and new, while the second table on this page looks more specifically at direction finding (DF). In both tables, reference is made to Libsidekiq, which is Epiq's unified software library which provides a common framework across all of our small form factor (SFF) radios.

Contact us for more in-depth discussions of your unique needs, or visit **our website**. For more in-depth information on DeepSig's capabilities **contact them**, or visit **their website**.



ABOUT EPIQ

Epiq Solutions develops cutting edge tools for engineering teams and government-focused organizations requiring situational awareness and detailed insight into their RF environments in order to identify and act against wireless threats.

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