

CONTEXT

Automatic Modulation Recognition (AMR) or Automatic Modulation Classification (AMC) is the act of detecting and identifying a received signal. More precisely, the objective is to determine the employed modulation type of a sensed Radio Frequency (RF) signal at a given time, space and frequency. Spectrum awareness and monitoring are key challenges in the radio frequency domain and AMR is a fundamental part of it.

OBJECTIVES

The objectives are to investigate if using a decomposed signal as input instead of the raw IQ signal increases the overall classification accuracy. The adopted decomposition method is called Bivariate Empirical Mode Decomposition (BEMD)[1]. The question arises on how to feed the information of the IMFs into an AI architecture.

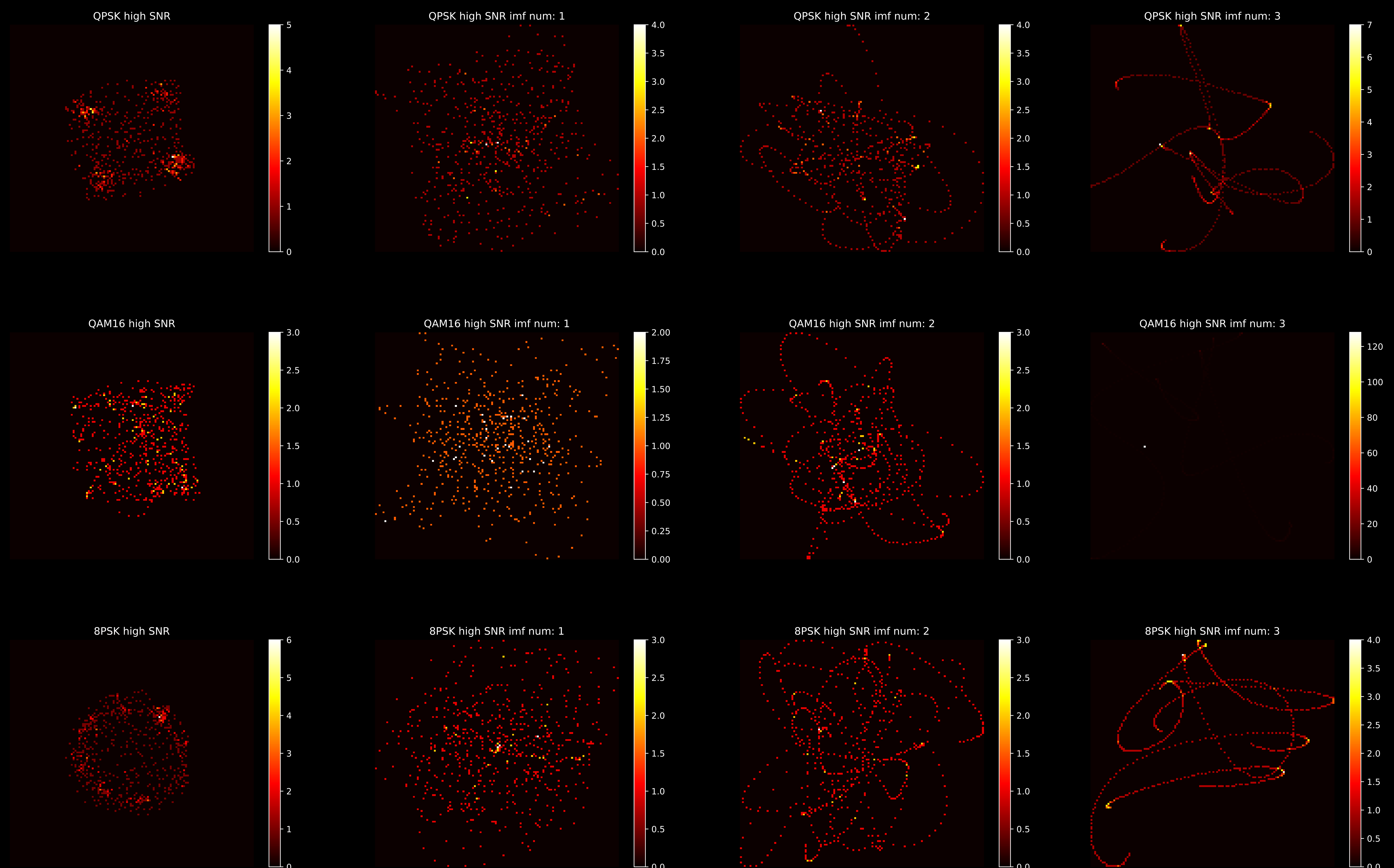
[1] Gabriel Rilling, Patrick Flandrin, Paulo Goncalves, and Jonathan M. Lilly. Bivariate empirical mode decomposition IEEE Signal Processing Letters

VECTOR DIAGRAM REPRESENTATIONS

It has been shown that applying a BEMD decomposition before training increases the overall classification accuracy (2%) of an CNN architecture. Another data representation is called a vector diagram in which amplitude and phase time series can be plotted into an p by p complex plane.

BIVARIATE EMPIRICAL MODE DECOMPOSITION

EMD is a decomposition method that does not need a basis defined a priori but uses data driven basis functions. It consists in an iterative process called sifting and decomposes the signal $s(t)$ in a finite number of N IMFs: $s(t) = \sum_i^N IMF_i(t) + r(t)$. BEMD is the bivariate version of the EMD algorithm, where oscillations become rotations.



FUTURE STAGES

The next steps consist in analysing the vector diagrams of the decomposed IMFs. Modulation classification of these images can be achieved using a CNN architecture. Improved vector diagrams highlighting high density areas (colored diagrams) can be used. For instance, the first three IMFs are placed into the three image channels of the input tensor. Lastly, the behaviour of rotating constellations (phase shifts) using these methods should be considered.