International Workshop on
Machine Learning for Space Weather:
Fundamentals, Tools and Future Prospects

7-11 November 2022
This is a hybrid meeting
Buenos Aires, Argentina

HANDS-ON SESSION

THE PROBLEM

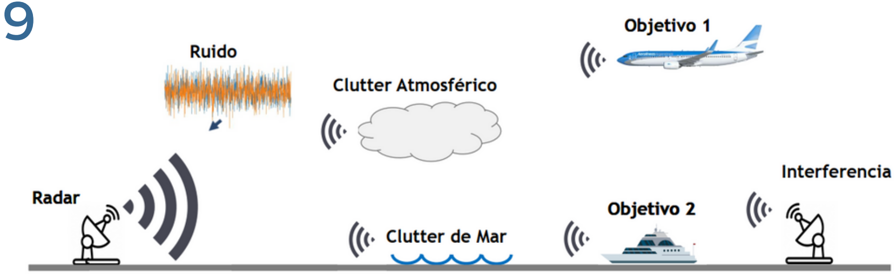
Classification of radar echoes from the ionosphere ("good" or "bad").

1989

VINCENT G. SIGILLITO, SIMON P. WING, LARRIE V. HUTTON, and KILE B. BAKER

CLASSIFICATION OF RADAR RETURNS FROM THE IONOSPHERE USING NEURAL NETWORKS

In ionospheric research, we must classify radar returns from the ionosphere as either suitable for further analysis or not. This time-consuming task has typically required human intervention. We tested several different feedforward neural networks to investigate the effects of network type (single-layer versus multilayer) and number of hidden nodes upon performance. As expected, the multilayer feedforward networks (MLFN's) outperformed the single-layer networks, achieving 100% accuracy on the training set and up to 98% accuracy on the testing set. Comparable figures for the single-layer networks were 94.5% and 92%, respectively. When measures of sensitivity, specificity, and proportion of variance accounted for by the model are considered, the superiority of the MLFN's over the single-layer networks is even more striking.

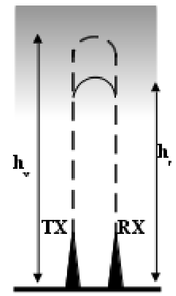


$$Eco(t) = Atte \cdot RCS \cdot u(t) \cdot m(t) \cdot e^{j\omega_c t \pm j\omega_D t + \varphi}$$

$$S_R(t) = Eco(t) + Clutter\ (t) + Ruido(t) + Interferencia(t)$$

Paper source:
Sigillito, V. G., Wing, S. P., Hutton, L. V., \& Baker, K. B. (1989). Classification of radar returns from the ionosphere using neural networks. Johns Hopkins APL Technical Digest, 10, 262-266.

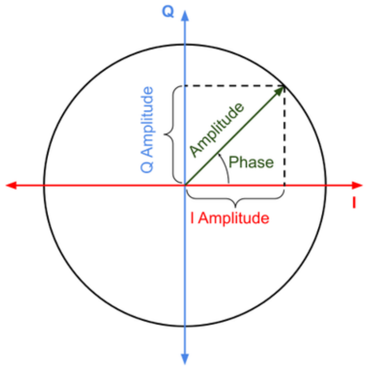
Data source:
Space Physics Group of the Johns Hopkins University Applied Physics Laboratory.

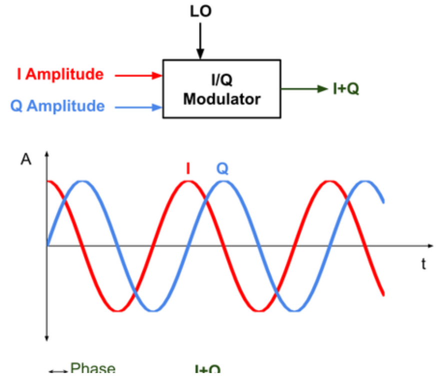


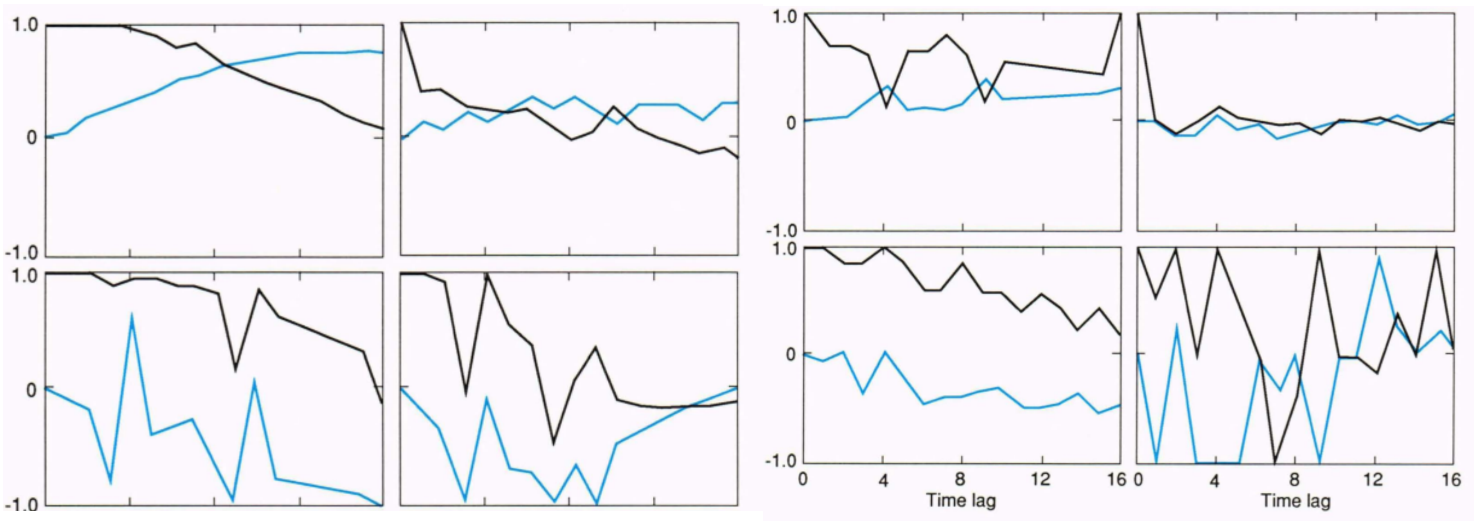
*: "target" = ionosphere

IQ Modulation: it is a specific Phase-Modulation type, that provides us certain information in the real component of the signal and another posible coded information in the imaginary part. We can obtain both of them using demodulation techniques such as quadrature hybrids.

$$C(t) = A(t) + iB(t)$$







Good echo *Bad echo* *Good echo* *Bad echo*

Auto-Correlation Function Output

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