Gradient pattern analysis of solar radio bursts

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Several investigations exist which are dedicated to the understanding of spatio-temporal and spectral properties of solar active regions. In particular, spatially extended systems, as coronal loops, yield complex spatio-temporal patterns arising from the nonlinear MHD instabilities and correlated processes as turbulent, chaotic and reactive-diffusive dynamics. Such processes can be characterized from short time series (less than 10^4 measurements) using the dynamic ranges of the first gradient moment $g_{1,a}$, for gradient asymmetry (e.g., Assireu et al., Physica D 397:168, 2002; Costa-Junior et al., Physica A 344:447,2004). The gradient pattern analysis is used to report a phenomenological evidence of hybrid dynamics for radio bursts observed at 1.6, 3.0 and 17.0 GHz. This is interpreted as the temporal signature of a complex spatio-temporal dynamics coming from multi-scaling flare loop nonlinear interactions. We found different γ parameters, where $\gamma = \Delta g^*/\Delta g$ with Δg^* as asymmetry turbulent range, charactering the presence of turbulent (γ=1.0), chaotic (γ=0.75) and reactive-diffusive (γ=0.50) regimes when considering scaling free processes as intermittency and coherent states driving the loop system MHD coalescence instabilities.