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Abstract. This article develops a robust method for formulating a decision function in automatic optoelectronic navigation systems to ensure operational accuracy and stability under highly distorted current images. This is achieved through the sequential application of the polynomial fractional Fourier transform, the log-polar Mellin transform, and a two-stage Tikhonov regularization scheme. For the first time, an image formation method is proposed based on the spatial-frequency separation of the signalnoise mixture and dynamic motion blur compensation within the integral transform operators. The method automatically searches for optimal fractional-order parameters by minimizing the Rényi spectral entropy. A scale-invariant model strictly distinguishes between intra-frame blurring compensation in the fractional frequency domain and inter-frame carrier altitude variation elimination within the Mellin operator. Analytical expressions for the optimal Tikhonov regularization parameters are derived and evaluated in real time via Hansen's L-curve curvature maximization without computationally expensive matrix inversions. This mathematical approach ensures strict decision function unimodality verified by the Sylvester criterion under extreme signal-to-noise ratios (down to –15 dB) without reliable landmarks or landmarks availability. Numerical simulations in Python using real-world aerial imagery under angular heading evolutions within ± 15° confirmed a reduction in the root-mean-square error (RMSE) of groundbased coordinate localization by more than a factor of 20 compared to classical spatial correlation algorithms, achieving a framing processing time of 12–25 ms on an ARM architecture. The scientific novelty lies in substantiating a new fifth-generation navigation system concept, wherein noise spectrum and destructive dynamic blur separation occurs strictly at the spatial-frequency level.

Keywords: spectral-energy representation of current images, polynomial fractional Fourier transform, Mellin transform, Tikhonov regularization, unimodal decision function, dynamic image blurring, informative features, fifth-generation navigation system.