

Planar current fields

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Given a complex function $\psi : D \subset \mathbb{C} \longrightarrow \mathbb{C}$, $\psi(x + iy) = u(x, y) + iv(x, y)$, called wave function, we define the current field $\mathcal{J} : D \subset \mathbb{R}^2 \longrightarrow \mathbb{R}^2$ as follows

$$\mathcal{J}(x, y) = u(x, y)\nabla v(x, y) - v(x, y)\nabla u(x, y),$$

where ∇ stands for the gradient operator. We analyze the phase portraits of $\mathcal{J}$ when the wave functions are holomorphic or meromorphic with emphasis on the special cases in which the wave function is polynomial or rational. Studies related to this subject are being developed in collaboration with D.C. Braga, A.F. Fonseca and R.M. Ribeiro.
