Extrinsic geometric foliations on surfaces in $\mathbb{R}^4$

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Consider a surface in $\mathbb{R}^4$ defined as the transversal intersection of the inverse image of fixed values of two real differentiable functions. The gradients of these functions determine a pair of principal foliations on the surface. We analyze a quadratic differential equation defining these foliations. We apply this approach to provide global descriptions of asymptotic and curvature lines of compact surfaces of genus greater than one, embedded in the three dimensional sphere in $\mathbb{R}^4$. Moreover, this description allow us to study the principal foliations of immersions of such surfaces in the Euclidean space of dimension three. We analyze in detail the case of the double torus whose principal foliations have interesting structure. This presentation is about a joint work with María García Monera and Vinicio Gómez Gutiérrez.