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Geometric substructures, uniruled projective subvarieties, and applications to Kähler geometry

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In a series of articles with Jun-Muk Hwang starting from the late 1990s, we introduced a geometric theory of uniruled projective manifolds based on the variety of minimal rational tangents (VMRT), i.e., the collection of tangents to minimal rational curves on a uniruled projective manifold $(X;K)$ equipped with a minimal rational component. This theory provides differential-geometric tools for the study of uniruled projective manifolds, especially Fano manifolds of Picard number 1. Associated to $(X;K)$ is the fibered space $\pi:C(X)\rightarrow X$ of VMRTs called the VMRT structure on $(X;K)$. I will discuss germs of complex submanifolds S on $(X;K)$ inheriting geometric substructures, to be called sub-VMRT structures, obtained from intersections of VMRTs with tangent subspaces, i.e., from $\omega:C(S)\rightarrow S$, $C(S):=C(X)\setminus PT(S)$. Central to our study is the characterization of certain classical Fano manifolds of Picard number 1 or special uniruled projective subvarieties on them in terms of VMRTs and sub-VMRTs. As applications I will relate the theory to the existence and uniqueness of certain classes of holomorphic isometries into bounded symmetric domains. For uniqueness results parallel transport (holonomy), a notion of fundamental importance both in Kähler geometry and in the study of sub-VMRT structures, will play an important role.

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