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*Regularity for invariant densities of switching systems*

Consider a finite collection  $D$  of smooth vector fields on  $\mathbb{R}^n$ . Given an initial vector field  $u \in D$ , we flow along  $u$  for a random time. Then, we switch to a new vector field that is randomly chosen from  $D$ . We flow along the new vector field for a random time and make another switch. Reiterating this procedure, we obtain a Markov process on  $\mathbb{R}^n \times D$ . If the associated semi-group admits an absolutely continuous invariant measure with density  $\rho$ , we can ask whether the projections  $(\rho_u)_{u \in D}$  have smooth representatives. Another natural question is whether these projections have singularities. In dimension 1, under mild assumptions on  $D$ , singularities can only occur at critical points of the vector fields and the projections are smooth at noncritical points. In dimension 2, singularities may also form at noncritical points, which we will illustrate with a basic example. Whether and where singularities occur depends critically on the rate of switching. The talk is based on work with Yuri Bakhtin, Sean Lawley and Jonathan Mattingly.