Functional Itô-formula and Taylor expansions for non-anticipative maps of càdlàg rough paths

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Abstract

We rely on the approximation properties of the signature of càdlàg rough paths to derive a functional Itô-formula for non-anticipative maps of rough paths. This leads to a functional extension of the Itô-formula for càdlàg rough paths (by Friz and Zhang (2018)) which coincides with the change of variable formula formulated by Dupire (2009) whenever the functionals' representations, the notions of regularity, and the integration concepts can be matched. In contrast to these works, by treating the vertical (jump) pertubation via the Marcus transformation, we can also incorporate path functionals where the second order vertical derivatives do not commute as it is the case for typical signature functionals. As a byproduct, we show that sufficiently regular non-anticipative maps admit a functional Taylor expansion in terms of the path's signature, leading to an important generalization of the recently established results by Dupire and Tissot-Daguette (2022).

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