

# Notes on area operator, geometric 2-rough paths and Young integral when $p^{-1}+q^{-1}=1$

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1. When equipped with 2-rough norm and restricted to continuous paths with bounded variation, the area operator is a closable unbounded operator. 2. The area defined through Riemann-Stieltjes integral is the only possible candidate to enhance a path with vanishing 2-variation into a geometric 2-rough path. 3. Young integral is extended to  $p^{-1}+q^{-1}=1$  by assigning a finer scale continuity.

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