

# A Distributional Investigation of Progressive Differential Operators

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The application of distributional techniques in a Schwartz-Sobolev space setting to the progressive differential operators are presented. The investigation starts with the standard (gradient, divergence, curl, Laplacian; time derivative) operators followed by the progressive (convective and Oldroyd derivatives) differential operators acting on the regular and singular components of a distribution. The regular components of a Schwartz-Sobolev distributions are described in the space of locally integrable functions in the Lebesgue sense, whereas the singular components are assumed to be constructed via the Dirac delta distributions of arbitrary order concentrated on a point, a regular surface and a regular space curve, respectively. By extending the definition of the standard spatial vector operators from the space of continuous functions to the space of distributions, their action on a field quantity in the Lebesgue space are described in a concise manner through a set of nine “generalized vector operators” first defined and used by Remus Rădulet in 1955 in his undergraduate textbook available only in Romanian language. We also provide commutative relations between the standard and progressive differential operators, which are the basic tools in construction of field theories based on material invariance (or frame indifference) principle.

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