

# Some generalizations of the Noether theorem: differential and difference equations

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## **Abstract**

It is known from the Noether theorem that the invariance of the variational functional with respect to an  $r$ -parameter group leads to the existence of  $r$  conservation laws for the corresponding Euler's equation. We show that there exist  $r$  equations associated with Euler's equation and that these equations possess their own conservation laws. Some of these equations can be viewed as the Euler equations of variational functionals. A similar situation can be observed for finite-difference equations. Several examples of ODEs and PDEs are considered.