World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:18, No:08, 2024

Hardy Type Inequalities of Two-Dimensional on Time Scales via Steklov Operator

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Abstract : The mathematical inequalities have been the core of mathematical study and used in almost all branches of mathematics as well in various areas of science and engineering. The inequalities by Hardy, Littlewood and Polya were the first significant composition of several science. This work presents fundamental ideas, results and techniques and it has had much influence on research in various branches of analysis. Since 1934, various inequalities have been produced and studied in the literature. Furthermore, some inequalities have been formulated by some operators; in 1989, weighted Hardy inequalities have been obtained for integration operators. Then, they obtained weighted estimates for Steklov operators that were used in the solution of the Cauchy problem for the wave equation. They were improved upon in 2011 to include the boundedness of integral operators from the weighted Sobolev space to the weighted Lebesgue space. Some inequalities have been demonstrated and improved using the Hardy–Steklov operator. Recently, a lot of integral inequalities have been improved by differential operators. Hardy inequality has been one of the tools that is used to consider integrity solutions of differential equations. Then dynamic inequalities of Hardy and Coposon have been extended and improved by various integral operators. These inequalities would be interesting to apply in different fields of mathematics (functional spaces, partial differential equations, mathematical modeling). Some inequalities have been appeared involving Copson and Hardy inequalities on time scales to obtain new special version of them. A time scale is defined as a closed subset contains real numbers. Then the inequalities of time scales version have received a lot of attention and has had a major field in both pure and applied mathematics. There are many applications of dynamic equations on time scales to quantum mechanics, electrical engineering, neural networks, heat transfer, combinatorics, and population dynamics. This study focuses on double integrals to obtain new time-scale inequalities of Copson driven by Steklov operator. They will be applied in the solution of the Cauchy problem for the wave equation. The proof can be done by introducing restriction on the operator in several cases. In addition, the obtained inequalities done by using some concepts in time scale version such as time scales calculus, theorem of Fubini and the inequality of H¨older.

Keywords : time scales, inequality of Hardy, inequality of Coposon, Steklov operator
Conference Title : ICHPS 2024 : International Conference on Hilbert Problems and their Solutions
Conference Location : New York, United States
Conference Dates : August 08-09, 2024