**Multi-objective function**

Optimization of objective functions is commonly required in control systems. The use of metahuristic algorithms to achieve optimization is one of the methods that has gained popularity in recent years. In this paper we have addressed the problem of tuning a FOPID to give an optimal response for a plant.

To effectively tune the controller various objective functions have to be considered simultaneously in the form of a multi-objective function instead of considering only one performance index such as ITAE or IAE. The multi-objective solution strives to strike a balance between various objectives. If the objectives are conflicting, a distinct Pareto optimal solution can not be determined. In this case any solution can be chosen from the Pareto front.

The objectives considered for tuning the FOPID are: overshoot, rise time, settling time and ITAE. The multi-objective function is taken as the weighted average of these objectives. Since ITAE is selected over the other performance indices (ITSE and ISE) as it is the most sensitive. The relative weights of the parameters used in the multi-objective function have be adjusted according to the desired response of the system. The function used is given as follows- <insert formula>