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Approximate Analytical Solutions for Transient Heat Transfer in Two-Dimensional Straight Fins

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Abstract: In this paper we analyse the heat transfer in two-dimensional straight fins. Both heat transfer coefficient and thermal conductivity are temperature dependent. The resulting 2+1 dimension partial differential equation (PDE) is rendered nonlinear and difficult to solve exactly, particularly with prescribed initial and boundary conditions. The three-dimensional differential transform method (3D DTM) is used to construct the approximate analytical solutions. The effects of parameters, appearing in the boundary value problem (BVP), on temperature profile of the fin are studied.

Keywords: *3D DTM; approximate solutions; 2D staright fins, heat transfer.*

Mathematics Subject Classification (2010): 35K57, 35G30, 35K05, 74A15, 41A58.

1 Introduction

Fins are surfaces that extend from a primary body to a surrounding fluid. They are predominantly used to increase the heat transfer rate between the body and its surroundings. Fins are designed in such a way that they increase the surface area of an object and hence its contact with the environment. They come in various shapes, geometries and profiles that cater for a diverse range of problems and applications (the reader is referred to [1] for a detailed theory). Fins are widely used in devices that exchange heat, common examples would include vehicle engine radiators, refrigerators, air conditioning devices and compressors. Consequently, the study of heat transfer in fins continues to be of interest.

Two-dimensional fin problems have received much attention, however, it is assumed in most works that the thermal conductivity and the heat transfer coefficient are constants, and the internal heat generation is omitted. In [2], the authors provided the approximate

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