UNIVERSITÀ DEGLI STUDI DI BERGAMO | Dipartimento di Ingegneria e Scienze Applicate

# Selected Solution Methods for Nonlinear Partial Differential Equations for Flow and Heat Transfer Problems


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**Seminar organised within the framework of the DROPIT Project**

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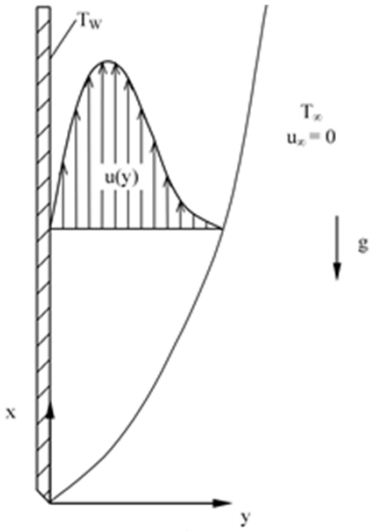
## ABSTRACT

In most of the Bachelor- and Master courses students learn a lot about the solution methods of linear partial differential equations in Fluid Mechanics and/or in Heat Transfer. However, in most technical applications, problems are often described by nonlinear partial differential equations. For a lot of these applications, the equations have to be solved by numerical methods.

In contrast to the large amount of literature dealing with the solution of linear partial differential equations, much less literature exists on the solution of nonlinear partial differential equations. One of the major difficulties arising in the solution of nonlinear problems is that we are no longer able to use the powerful superposition method for constructing solutions as for linear problems.

The present short course will try to give a first small inside into possible solution methods for nonlinear partial differential equations. It will be intended to provide a short overview on some selected solution methods for nonlinear partial differential equations occurring in heat transfer and fluid flow problems. The solution approaches presented will include, for example, the method of separation of variables, the Kirchhoff transformation methods, and special solutions of the energy equation. However, the focal point of this short course is on similarity solutions for the heat conduction and boundary layer equations. Here an overview is given on different methods and on how to determine these solutions. Similarity solutions are not only of importance because they may lead to analytical solutions of the underlying nonlinear partial differential equations, but also, because they play today an very important role as excellent benchmark cases for testing and validating computer codes and numerical schemes.




*Free convection flow along a vertical flat plate. The flow and heat transfer for this case can be obtained from a similarity solution of the boundary layer equations and the energy equation.*


**Ph.D. students of ISA and TIM Doctorates are specially invited**

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