THE APPLICATION OF CONFORMAL MAPPING TECHNIQUES TO 2D SHAPE ANALYSIS, CO-ORDINATE TRANSFORMATION AND AERODYNAMICS.

Submitted by Thomas Mathew, Assistant Professor,Dept. of Mathematics, St. Thomas College, Kozhencherry

ABSTRACT

Conformal mapping method is a promising problem solver in the areas of physics, Engineering and Aerodynamics due to its increasing speed of digital computation and decreasing cost. Conformal mapping has the ability to handle both interior and exterior fields, with boundaries extending to infinity. The purpose of this minor research project is to rekindle interest in conformal mapping by illustrating its wide applicability and describing new mathematical techniques so that one can develop new applications in various fields with more speed and accuracy.

A conformal map is a complex function f : C C which preserves the angles and shape of infinitesimal small figures but not necessarily their size. The physical problem involving steady state heat flow, electrostatics, and ideal fluid flow are real-world applications and involve solutions in three dimensional Cartesian spaces. Such problems generally would involve the Laplacian in three variables and the divergence and curl of three dimensional vector functions. Since complex analysis involves only x and y, we consider the special case in which the solution does not vary with the coordinate along the axis perpendicular to the XY-plane.

In Aerodynamics, the Joukowski transformation $f(z) = z + 1/z$ which is conformal converts circular cylinder into a family of airfoil shapes. This mapping function converts the entire flow field around the cylinder into the flow field around the airfoil. If the velocity and pressures in the plane containing the cylinder are known, then the mapping function gives us the velocity and pressures around the airfoil. Knowing the pressure around the airfoil, we can then compute the lift. The computations are difficult to perform manually, but can be solved quickly using computer. Conformal mapping methods are useful in cortical brain flattening. It is mathematically impossible to flatten curved surfaces without metric and area distortion. Nevertheless, "metric" flattening has flourished based on a variety of computational methods that minimize distortion. However, it is mathematically possible to flatten without any angular distortion.

. Conformal mapping is applied in the field of Transmission lines and wave guides, Vibrating lines and acoustics, Stresses and strains in an elastic medium, Steady state and transient heat conduction, Fluid flow, Magneto hydro dynamics, Vibrations of solid propellant rocket motors etc. The Schwarz Christoffel method of conformal mapping is used to solve some problems in geophysics. Conformal Mapping is a field in which pure and applied mathematics are both involved. This Project tries to bridge the gulf that many times divides these two disciplines by combining the theoretical and practical approaches to the subject. The field of conformal mapping is very useful for Engineers, Physicist and both pure and applied mathematicians.