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THE LAPLASIAN IN STRETCHED POLAR COORDINATES AND APPLICATION

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The most part of BVP relevant to the Laplacian are solved in explicit form only for very particular domains, namely intervals, cylinders or characterized by special (circular or spherical) symmetries.

We consider in this lecture an extension of the classical two-dimensional theory to the case of a normal polar domain, i.e. a domain $\mathcal{D}$, which is normal with respect to the polar co-ordinate system. Therefore, $\partial\mathcal{D}$ can be interpreted as an *anisotropically stretched unit circle*.

We derive closed forms for the solutions of some very classical problems in terms of Fourier-type expansions, and we write down explicitly the infinite systems of equations to solve for computing the relevant coefficients.

Numerical experiments by using the Computer Algebra System Mathematica ©, confirming our results for the solution of the Dirichlet problem for the Laplace equation, are presented.