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Positive Solutions of Separated Boundary Value Problems

In this talk, we prove the existence of positive solutions for a one-dimensional separated boundary value problem. To be more specific, we study the existence of nonzero nonnegative, or strictly positive, solutions of nonlinear second-order differential equations with separated boundary conditions, in which the parameters may have negative values. We also assume that the nonlinear part can take negative values. The solution to this boundary value problem can be considered as a steady-state solution for a reaction-diffusion-advection equation with logistic-type nonlinearity, which can be applied to model the dynamics of a species in a stream. One of the boundary conditions corresponds to upstream, where there is no flux, and the other one to downstream, where the flux across the boundary is proportional to the density. We prove the result by rewriting the boundary value problem as a Hammerstein integral equation. To do this, we use the Nemytskii operator corresponding to non-linearity and the Green's function for the homogeneous second-order differential equation. After proving the appropriate properties of the operator, we apply a fixed point theorem for r-nowhere normal-outward maps to prove the existence of solutions to our problem.

This is a joint work with Prof. Kunquan Lan at Toronto Metropolitan University and Prof. Jianhong Wu at York University.