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Existence and uniqueness for nonlinear boundary value problems on infinite intervals. (English) Zbl 0719.34037

J. Math. Anal. Appl. 147, No. 1, 122-133 (1990).

The author considers the boundary value problem (1) $y'' = f(x,y,y')$, $0 \le x < \infty$, (2) $a_0 y(0) = a_1 y'(0) = A$, $a_0 \ge 0$, $a_1 \ge 0$, $a_0 + a_1 > 0$, (3) $y(\infty) = B$. The basic assumptions on the function f(x,y,z) are: f(x,y,z) is continuous on $I \times \mathbb{R}^2$, $I = [a,b]$, for $0 < b < \infty$; f(x,y,z) is nondecreasing in y for each fixed pair (x,z)$\in I \times \mathbb{R}$; f(x,y,z) satisfies a uniform Lipschitz condition on each compact subset of $I \times \mathbb{R}^2$ with respect to z; and zf(x,y,z)≤ 0 for $(x,y,z) \in I \times \mathbb{R}^2$, $z \ne 0$. Using the shooting method, and with additional assumptions on f(x,y,z) and supposing that a_0, a_1 are both positive, he proves that the boundary value problem (1)-(3) has a unique solution.

The following example $y'' = -2xy'/(1-\alpha y)^{1/2}$, $0 \le x < \infty$, $y(0) = 1$, $y(\infty) = 0$, which arises in nonlinear mechanics in the problem of unsteady flow of gas through a semi-infinite porous medium, $0 < \alpha \le 1$, is given.

Reviewer: M.Shahin (Dallas)

MSC:

34B15	Nonlinear boundary value problems for ordinary differential equations	Cited in **61** Documents
34A45	Theoretical approximation of solutions to ordinary differential equations	
76S05	Flows in porous media; filtration; seepage	

Keywords:

boundary value problem; shooting method; unique solution; example; unsteady flow of gas through a semi-infinite porous medium

Full Text: DOI

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