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A BVP nonexistence proof using Green's Theorem

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Abstract

Several recent papers investigate the boundary value problem

$$\phi''(t) + \lambda\phi'(t) + \phi(t)^2 = 0, \quad t \geq 0$$

subject to

$$\phi(0) = 1, \quad \phi(\infty) = 0,$$

which arises in certain situations of boundary layer flow. Previous work on the problem established the existence of a $\lambda_{\min} \in [1, 2/\sqrt{3}]$ such that solutions exist for $\lambda \geq \lambda_{\min}$. It has been conjectured that for $\lambda < \lambda_{\min}$ no solution exists. We improve existing results by proving that for $\lambda < \lambda_1 \approx .96105$ no solution to the boundary value problem exists. The proof employs a novel application of Green's Theorem and is applicable to other boundary value problems.

keywords: boundary value problem, nonexistence, Green's Theorem

AMS Mathematics Subject Classification: 34B15, 76D10

1 Introduction

In [2] and [3], Magyari *et. al.* consider the boundary value problem (BVP):

$$\phi''(t) + \lambda\phi'(t) + \phi(t)^2 = 0, \quad t \geq 0, \tag{1.1}$$