

A NON-LOCAL BOUNDARY VALUE PROBLEM WITH INTEGRAL CONDITIONS FOR A SECOND ORDER HYPERBOLIC EQUATION

(Suatu Masalah Nilai Sempadan Tak-Setempat dengan Syarat Kamiran bagi Suatu Persamaan Hiperbolik Peringkat Kedua)

Y.T. MEHRALIYEV & E.I. AZIZBEKOV

ABSTRACT

In this paper, the classic solution of one-dimensional boundary value problem for a hyperbolic equation with non-classic boundary conditions is investigated. For that, the stated problem is reduced to the not-self-adjoint boundary value problem with equivalent boundary condition. Then, using the method of separation of variables, by means of the known spectral problem the given not self-adjoint boundary value problem is reduced to an integral equation. The existence and uniqueness of the integral equation are proved by means of the contraction mappings principle and it is shown that this solution is unique for a not-adjoint boundary value problem. Finally, using the equivalence, the theorem on the existence and uniqueness of a non-local boundary value problem with integral condition is proved.

Keywords: Mixed problem; contracted mappings; fixed point; hyperbolic equation

ABSTRAK

Dalam makalah ini, penyelesaian klasik bagi masalah nilai sempadan matra satu untuk persamaan hiperbolik dengan syarat sempadan tak-klasik dikaji. Untuk itu masalah tersebut diturunkan kepada masalah nilai sempadan tak-swadampingan dengan syarat sempadan yang setara. Dengan menggunakan kaedah pemisahan pemboleh ubah, melalui masalah spektrum yang diketahui masalah nilai sempadan yang tak-swadampingan tersebut diturunkan kepada suatu persamaan kamiran. Kewujudan dan keunikan bagi persamaan kamiran tersebut dibuktikan dengan menggunakan prinsip pemetaan pengecutan dan ditunjukkan bahawa penyelesaian ini adalah unik bagi masalah nilai sempadan tak-dampingan. Akhir sekali, dengan menggunakan kesetaraan, teorem kewujudan dan keunikan bagi masalah nilai sempadan tak-setempat dibuktikan.

Kata kunci: Masalah campuran; pemetaan mengecut; titik tetap; persamaan hiperbolik

References

- Beilin S. 2001. Existence of solutions for one-dimensional wave equations with nonlocal condition. *Electronic J. of Differ. Equat.* **76**: 1-8.
- Bouziati A. 1997. Solution forte d'un probleme mixte avec conditions non locales pour une classe d'equations hyperboliques. Bulletin de la Classe des Sciences. *Academie Royale de Belgique* **8**: 53-70.
- Ionkin N. I. 1977. Solutions of boundary value problem in heat conduction theory with nonlocal boundary conditions. *Differents. Uravn.* **13** (2): 294-304.
- Kasumov T.B. & Mirzoyev V.S. 2007. On one generalisation of Ionkin's example. *The abstracts of scientific conference devoted to 100th anniversary of the honored scientist acad. A.I.Huseynov*: 87-88. Baku.
- Khudaverdiyev K.I. & Azizbekov E.I. 2002. Investigation of classical solution of a one-dimensional not self-adjoint mixed problem for a class of semi-linear pseudohyperbolic equations of fourth order. *Vestnik Bakinskogo Gosudarstvennogo Universiteta, phys.-math. ser.* **2**: 114-121.
- Mehrliyev Y.T. & Yusifov M.R. 2009. The solution of a boundary value problem for a second order parabolic equation with integral conditions. *Proceedings of IMM NAS of Azerb.* **30**: 91-104.
- Pulkina L.S. 2004. Non local problem with integral conditions for a hyperbolic equation. *Diff. Uravnen.* **40** (7): 887-892.

Y.T. Mehraliyev & E.I. Azizbekov

*Mechanics-Mathematics Faculty
Baku State University
Baku, AZERBAIJAN
E-mail: azel_azerbaijan@mail.ru*