# Nonlocal boundary value problem for telegraph equation

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In development of electro-mechanic devices it is desirable for engineers to be able to evaluate the signal parameters or it propagation quality in the system without physically manufacturing the chip and performing measurement. This derives us to consider the nonlocal boundary value problems for telegraphic equation. The special case of such conditions is integral conditions, which appear in case when it is impossible to measure directly some physical quantities (but we know their averaged values) or boundary of the domain is unavailable for measurement.

Such problems for hyperbolic equations, in general, are ill-posed and their solvability often related to the problem of small denominators [1]. The appearance of small denominators is caused by the presence of resonance phenomena in the physical system.

In domain $\mathcal{Q} := (0,T)\times(0,l)$ we consider the following problem

$$\partial_t^2 u + (a+b)\partial_t u + abu = c^2\partial_x^2 u + f(t,x), \quad (t,x)\in\mathcal{Q}, \tag{1}$$

$$u|_{t=T} = \varphi(x), \quad \int_0^T u(t,x)dt = \psi(x), \quad x\in(0,l), \tag{2}$$

$$u|_{x=0} = u|_{x=l} = 0, \quad t\in(0,T), \tag{3}$$

where $u = u(t,x)$, $a,b,c\in\mathbb{R}$, $a,b,c>0$, $f(t,x),\varphi(x),\psi(x)$ are given sufficiently smooth functions.

We established a sufficient conditions for the existence of solution of the problem (1)-(3) and constructed explicit formulas for the solution in the form of series.

*This work was supported by the budget program of Ukraine Support for the development of priority research areas (CPCEC 6451230).*

1. Ptashnyk B. Y. Ill-posed boundary value problems for partial differential equations. – Kyiv: Nauk. Dumka, 1984, 264.