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On new trend in BVPs for analytic and harmonic functions in the domains with non-smooth boundaries

The goal of our talk is to present our recent results on the solution of boundary value problems for analytic and harmonic functions in 'bad' domains. We plan to discuss the Riemann problem of linear conjugation and the Riemann-Hilbert problem for analytic functions; the Dirichlet problem for harmonic functions being real parts of generalized Smirnov class of analytic functions. The latter classes were introduced and studied by us on the base of variable exponent analysis.

In our opinion, the novelty of our results is a breakthrough in the theory of plane boundary value problems in three direction: investigation of the problem within the framework of nonstandard Banach function spaces (variable exponent Lebesgue spaces, Grand Lebesgue spaces and etc.). To solve the problems for multiply connected domains, and also in the case when boundaries of the domains have complicated geometrical structure occurring the cusps. We focus on complete descriptions of solvability picture and construction the solutions in explicit form. It is shown that depending on the geometry of boundary and space exponent the problem may turn out to be uniquely and non-uniquely solvable or, generally speaking, unsolvable at all. In the latter case we have found additional (necessary and sufficient) conditions for the given boundary functions ensuring the existence of a solution. In all cases of solvability we give the solutions in explicit form. The above-mentioned investigation is based on the nonlinear harmonic analysis methods, namely Cauchy integral's method in BVPs problems developed in our previous talks, papers, monographs.

The present talk is based on joint research with V. Paatashvili.