# NUMERICAL SIMULATION OF NEGATIVE STREAMER IN POINT TO PLANE ELECTRODE SYSTEM

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**Abstract.** This paper presents the application of structured irregular mesh, initially developed for fluid flows by Jasak [7], to the simulation of negative streamer in point-to-plane electrodes system. To validate the method, simulation of negative streamer in plane to plane electrodes system is performed in Nitrogen at atmospheric pressure considering the Dhali and Williams's conditions [14]. Then results obtained on the development of a negative streamer in point-to-plane electrodes system are presented.

## 1. INTRODUCTION

Electrostatic precipitators are very helpful for the filtration of the gases coming from nuclear wastes processing. Actually, they avoid strong pressure drops in the processes and limit the production of secondary wastes. In order to improve the efficiency of the filtration together with its endurance, a fundamental study concerning charge and discharge phenomena in the filtering device has been initiated.

Numerous studies have been devoted to the study of filamentary discharges which usually occur around atmospheric pressure and more generally for high values of the product of the gap distance and the gas pressure [1, 2, 3]. This interest was motivated at the beginning mainly in connection with the potential improvement of dielectric properties of insulating gases. Recently there is a renewed interest for this type of discharge due to new industrial applications (e.g. depollution, surface treatment). A review of corona plasma applications can be found in [4, 5].

If the complex shape of the electrodes has to be taken into account, there are two possibilities. The first one is to use an accurate numerical scheme on a regular orthogonal mesh and to model the electrodes by an immersed boundary technique. It gives very satisfactory results particularly with a 1D grid refinement strategy [6]. The second one is to use a structured but irregular mesh associated with a possible high order numerical scheme [16] – second order. The advantage of this second possibility is that it can be associated to a full 2D grid refinement technique.

In this context the aim of this paper is to show that structured irregular mesh associated with a numerical scheme of second order can be satisfactory used to model both the electrode shape and the development of negative streamer in the gap. The Finite Volume technique chosen here was first developed for fluid flows by Jasak ten years ago [7].

## 2. NUMERICAL MODEL

For streamer simulations in Nitrogen at atmospheric pressure, we use the following standard drift-diffusion equations, for electron and positive ions, coupled to Poisson's equation :

$$\frac{\partial N}{\partial t} + \nabla(\vec{U}N) = S \qquad (1)$$