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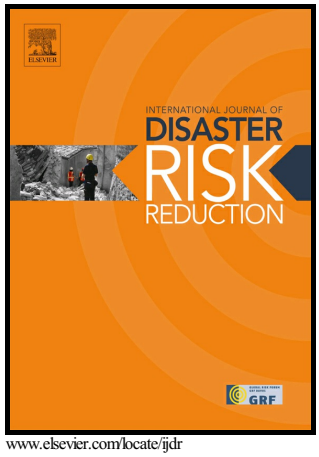

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Understanding Crowd Dynamics at Ghat regions during World's Largest Mass Religious Gathering, Kumbh Mela

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Abstract

In this paper a porous flow approach on a cul de sac is proposed to understand the dynamics of crowd at ghat regions (banks of the sacred river) in mass religious gatherings. Kumbh Mela, one of the mankind's largest religious gathering encompassing almost all possible crowd scenarios, provides a unique opportunity to explore the crowd dynamics along all facets. Here, Cul-de-sac refers to the ghat region where people gather with the intention to take holy dip. The data used for this study was collected during Kumbh Mela held during 22nd April to 21st May 2016. Visual observations from the video data shows a high degree of complexity probably due to the nature of activities at the study location, e.g., lane formation, creeping behaviour etc. The proposed porous flow approach divides the entire study area into pores, and it is assumed that pilgrims traverse this network through interconnected vacant pores. The pedestrian data from video sequences (entry time, exit time, and flow) is extracted manually and time series analysis of pore occupancy is done to get an approximate measure of local density. Further, using Poisson regression analysis it was found that both the inflow and the duration of holy dip are significant factors in influencing the number of arrivals into the pore. Since behavioral aspects of a pedestrian is a significant governing factor of crowd dynamics, these microscopic parameters can be used to get a measure of criticality of the system in terms of crowd risk.

Keywords: Crowd dynamics, Porous flow, Occupancy, Arrival pattern of pedestrians, Kumbh Mela, India

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