

工程与应用

地下矿CA粒子系统火灾蔓延仿真

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摘要 为了对火灾在地下矿巷道中的蔓延情况进行仿真, 提出了一个元胞自动机理论和粒子系统理论相结合的地下矿巷道系统中火灾蔓延仿真方法。针对地下矿巷道这个特殊环境, 采取可变邻域半径的元胞自动机模型来仿真火焰在巷道中蔓延的情景; 同时, 引入基于粒子系统的烟雾模型, 把燃烧着的元胞作为烟雾模型的粒子发射器。整个仿真系统基于同一时钟运行, 把时间、空间、火烟的物理行为有效地结合起来, 不仅能非常直观地仿真出火势蔓延态势和烟雾扩散运动过程, 并且通过在仿真过程中计算记录不同时刻火灾蔓延距离和入侵巷道烟雾粒子数量等数据, 可以获得大量巷道环境相关信息, 为逃生决策和火灾预防与控制提供依据。

关键词 [元胞自动机](#) [粒子系统](#) [火灾](#) [地下矿](#) [仿真](#)

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Fire spreading simulation in underground mine based on cellular automata and particle system

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Abstract

To simulate fire spreading along underground tunnel system and smoke distribution process during an underground mine fire disaster, a new computer simulation method based on cellular automata and particle system theory is proposed. Considering special environment in an underground mine's tunnel system, a cellular automata model, whose neighborhood radius is variable to simulate flame spreading, is employed; simultaneously a smoke model based on particle system using burning cells as launchers of smoke particles to describe smoke diffusion is introduced. The whole system runs based on a same clock. Time, space, and behaviors of flame and smoke are effectively combined together to obtain a better visual result. Accordingly, it can not only produce a sense of reality about tendency of fire spreading and motion of smoke, but also attain a large amount of information about real tunnel environment by recording spread distance of fire and quantities of smoke particles, all of which can provide a basis for fire prevention and control and also provide a decision-making support for workers evacuation.

Key words [cellular automata](#) [particle system](#) [fire disaster](#) [underground mine](#) [simulation](#)

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