

SEMINAR

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11:00 am - Noon

SSPA 2112

**“OR PRACTICE: PILGRIM SCHEDULING
FOR PUBLIC SAFETY DURING THE HAJJ”**

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Abstract

The Hajj - the great Islamic pilgrimage to Makkah, Saudi Arabia - is known to be the largest annually occurring pedestrian problem in the world with more than 3 million pilgrims each year. Pilgrims perform several religious rituals, including Ramy al-Jamarat - the stoning of the devil ritual - which is known to be particularly crowded. Until 2006, several sad crowd disasters with hundreds of casualties occurred. In the aftermath of the Hajj in 2006, several measures have been taken to improve safety and to avoid crowd disasters. One particular measure is the development of a time schedule for the pilgrims to perform the stoning ritual. In this paper, we present a model and a solution approach to the Pilgrim Scheduling Problem. The model minimizes the deviation of the scheduled stoning time from the preferred stoning time, while taking into account resource capacities (street width, for example) to avoid critical densities of pilgrims. At the same time pilgrims are assigned to routes leading to the ritual site. We solve the Pilgrim Scheduling Problem by an intelligible fix-and-optimize heuristic. Our approach has been an integral part of the planning of Hajj since 2006/2007 and no further crowd disaster has happened in the periods 2007-2014. We illustrate our work with computational results and validation data for the Hajj in 2014-

This contribution has been selected as a 2015 INFORMS Franz Edelman Award finalist (<https://www.informs.org/About-INFORMS/News-Room/Press-Releases/2015-Edelman-Finalists>)

** Dirk Helbing was only involved in the consultancy for the first successful implementation in 2007.*