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Editorial

Detection and Suppression of Fires: A Cornerstone of Fire Protection Engineering

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Early detection and suppression of fires has made a tremendous impact in reducing injuries and deaths due to fires. The affordable home smoke detector, which was recently awarded the prestigious DiNenno Prize by the National Fire Protection Association (NFPA), has made such an impact since its introduction in the 1960s that home fire deaths are estimated by the NFPA to have dropped by over 50% since the 1970s [1]. For fires in homes, the risk of dying is cut by about 30% when smoke alarms are present, while automatic fire sprinkler systems cut the risk of dying by about 80% [2]. These statistics demonstrate the tremendous impact seemingly simple technologies can have on life safety when properly implemented.

This special issues aims to review some of the notable advancements in the field of suppression and detection. Featured in this special issue are advancements in video fire detection, nuisance alarm reduction, and even automatic fire suppression for use on robotic platforms (Fig. 1).

Early detection of fires is critical to life safety, providing an opportunity for occupants to evacuate before succumbing to smoke and toxic gas inhalation and occasionally triggering active fire suppression systems. While smoke detectors have become one of the most common and effective means to prevent occupant deaths, they are still plagued by false alarms, which minimize their effectiveness. In our special issue, Dinaburg and Gottuk present a detailed review of current means to reduce nuisance alarms from cooking sources [3]. This knowledge is meant to better define how to implement new sections of NFPA 72, the National Fire Alarm and Signaling Code [4] as well as present a future roadmap for research. Milke and Zevotek also address false alarms in kitchens with a series of experiments, where they analyze signatures from different cooking fires in order to use this information to design smoke detectors that reduce future nuisance alarms [5]. A new technology is also presented by Jiang et al., which propose a combined smoke and CO gas detection method that can minimizes false alarms [6].

Video detection of fire is another emerging topic, increasing in prevalence as more occupancies are using alternative fire detection technologies, sometimes combined with full building monitoring. Similar to smoke detectors, video fire detection is also subject to false alarms, so optimization of the detection process is critical. Jia et al. have introduced a new smoke detection method which uses a

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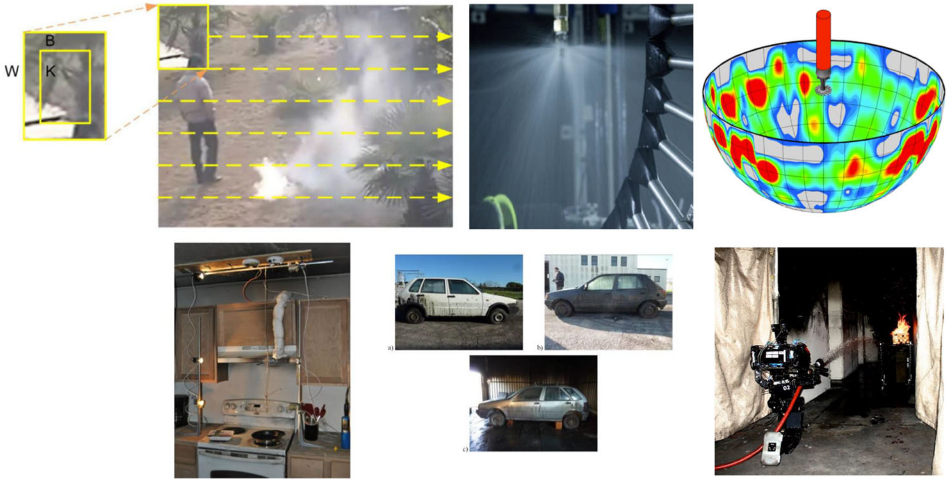

Figure 1. A variety of new technologies have emerged which will advance the current state of the art in suppression and detection of fires. A selection of these pictured above include (from *top left* to *bottom right*) a new saliency-based approach to video fire detection [7], accurate characterization of fire sprinkler sprays using the University of Maryland/Custom Spray Solutions (CSS) 4S system, characterization of nuisance fires from stovetops [5], effectively comparing the use of sprinkler versus water mist systems in diverse occupancies such as car parks [10] and a humanoid robot developed for fighting fires in shipboard occupancies (ExtReMe Lab, Virginia Tech).

combination of image segmentation and pixel classification based on saliency detection [7]. Another approach by Qureshi et al., called Quickblaze, applies another combined video processing approach to aid in the early detection of fires [8]. Finally, fire detection has even been applied to wildland fire applications through an approach based on color filtering [9]. By combining existing methods, these studies are able to improve the rate of detections and minimize false alarms.

A new approach for fire detection using multispectral inputs has also been designed to be used on autonomous, particularly robotic platforms by McNeil and Lattimer [10]. This system uses IR stereovision to determine the 3D location of a fire, which can then be extinguished by directing a hose stream using visual servoing. In the tests presented, the system was able to suppress wood crib fires in low visibility environments. In the future, autonomous fire suppression systems based on this technology may be used on a mobile robotic platform on naval ships to extinguish fires where it would be too dangerous for human firefighters to intervene.

New fire suppression technologies such as water mist have been proposed to replace traditional sprinklers in many occupancies, however the best means of applying these technologies to special occupancies hasn't been studied for all cases. In a series of large-scale fire tests by Santangelo et al., the performance of sprinkler vs. water mist systems is presented for use in car parks [11]. In both cases, the systems were capable of controlling the fire and preventing structural damage, however the water mist configuration tested performed better, especially when an additive was used. Jun et al. has also proposed a more detailed energy transport equation for the activation of circular fusible-type sprinklers which may aid in research and development of new designs [12].

Of course, the missing link in all of these technologies is notification of occupants that there is a fire so that they can evacuate in a timely manner. Bullough et al. has addressed this issue by focusing on the performance of xenon strobe light sources in notifying occupants of a building fire [13]. Using human factors experiments, they found effective intensity is poorly correlated with detection performance, instead proposing a modified metric, the indirect effectiveness quantity (IEQ) to predict indirect detection of visual signals with flashes longer than xenon light strobes (such as LEDs).

There is clearly a wide variety of ongoing research in the fields of fire detection and suppression. Despite the impact already made by existing systems, improvements proposed by new technologies have the potential to make great strides in further reducing life and property safety.

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