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Evaluation of billet quality in continuous casting process using thresholding techniques

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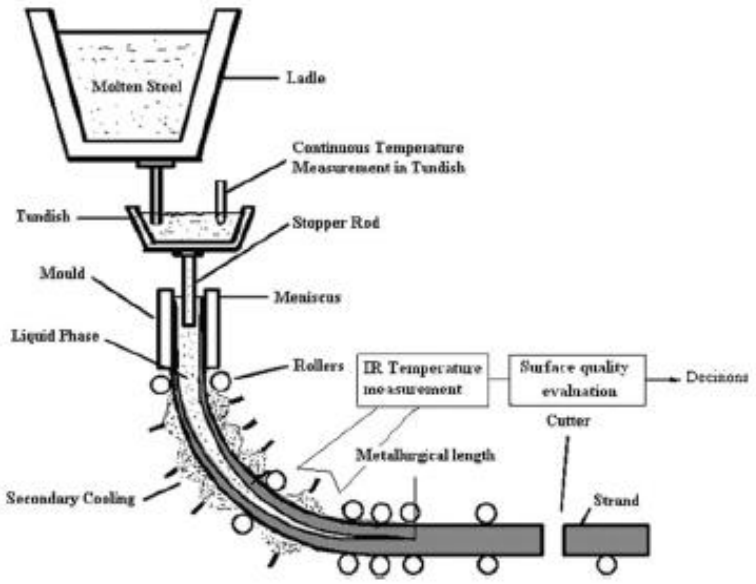
Abstract : A method for surface quality evaluation and temperature monitoring of the billet in continuous casting is considered in this paper. The temperature field, measured by an infrared camera, is affected by a metal oxide generated during the cooling process parameter called calamine. The quality of the billet's surface temperature is connected to the secondary cooling behavior, and therefore an evaluation of the calamine effect is needed. Thresholding Method is used for a global evaluation of calamine intensity on the monitored area of the billet in continuous casting. This kind of technique is applied in continuous casting process for constructing a complementary condition monitoring system, which allows an online calamine evaluation. Simulation results, based on the measured surface temperature and this technique, showed that this approach is easily implementable and gives good results when applied online.

Keywords : Infrared temperature measurement, Quality evaluation, Continuous casting, Surface billet casting, Thresholding techniques.

Fig. 1 Principle of surface quality evaluation in continuous casting



Thermographic measurements

The vision system elaborated within the framework of the research described in this work has been assigned to steel and iron process. The system has included hardware and software parts. The hardware part has consisted of a camera and a portable PC to make recordings in real time. The main task of this

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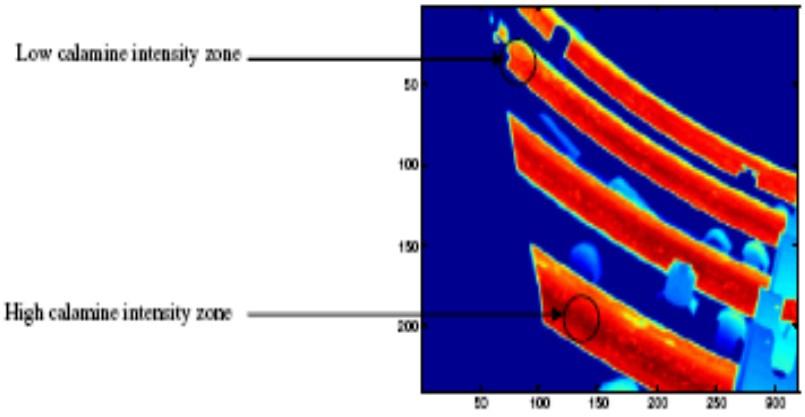
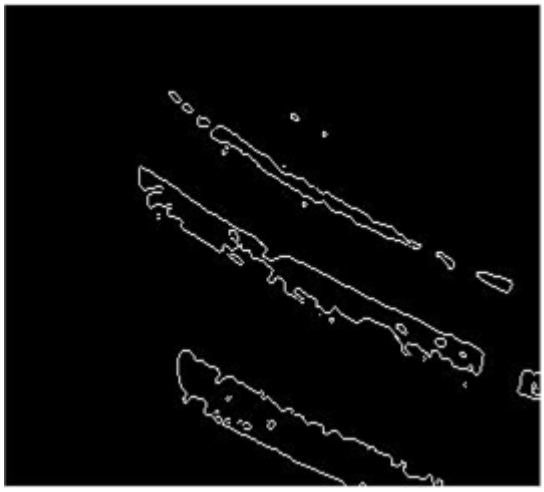
part was to observe the process by means of IR camera. The device used was a FLIR ThermaCAM A40 imaging system. It has a 240×320 pixels focal-plane-array uncooled microbolometer detector, with a sensitive range of 7.5-13 mm. Imaging and storage was made at a frequency rate of 50Hz. The PC is equipped by powerful software that is ThermaCam Researcher 2.9, this software is used to analyse dynamic IR radiation records including the emissivity calculations.

Results

Fig. 3 Thermographic image of strand billet in continuous casting





Edge detection of calamine in billet

calamine detection using SVM approach

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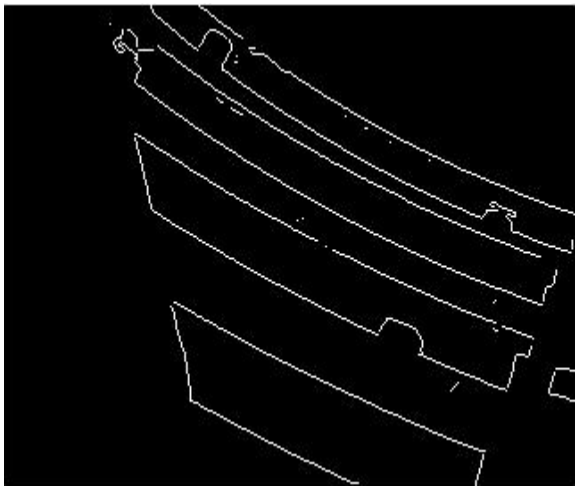

Calamine detection using Otsu method

Conclusion :

Infrared thermography technology is a nondestructive inspection technique. The inspection can be conducted efficiently by keeping a distance from the inspected equipment. There is no need to halt equipment operation while an inspection is going on. Since the collection of information for inspection is contactless, hazardous operations can be avoided. The main information gained from this technology is in the form of thermal image. Any abnormal condition of an inspected object will be reflected as an abnormal spot. The objective of this work is to visualize the anomalies existing in iron and steel industry during an inspection of continuous casting using A40 Flir camera. Then, we threshold these images in order to show the zone of interest and we make comparison between a few thresholding methods of thermal images obtained to choose the best one.