Microstructure Image Analysis for Estimating Mechanical Properties of Ductile Cast Iron

Abstract

The digital image processing and computer vision technologies have key role to play in the field of material manufacturing and quality control. The microstructure images of materials provide vital information about materials properties. The microstructure visual and mechanical properties are strongly related. The mechanical properties, namely, yield strength, tensile strength and elongation, of ductile iron are directly dependent on ferrite composition and nodularity value of the material. Castings with poor nodularity will exhibit lower tensile elongation and often do not meet minimum tensile strength and finally impact strength requirements. Hence, it is established by experimental results that the composition and nodularity value of the material have paramount importance in material manufacturing. In this paper, a novel automatic method of digital image analysis for estimating important mechanical properties with the help of microstructure visual properties has been proposed. Microstructure image analysis is performed for deriving microstructure properties, namely, nodularity value and percentage of ferrite phase present in material sample. A fuzzy rule based inference system is built using known authentic relationship data published in the research literature [3] to estimate important mechanical properties of the sample material using nodularity value and percentage...
of ferrite phase. With the inputs, namely, percentage of ferrite phase and nodularity values, to fuzzy inference system, the mechanical properties, namely, yield strength, tensile strength and elongation are predicted. The nodularity of the samples were determined by using image analysis techniques based on ASTM A 247-67(1968) standard. The automatic image analysis minimized the variability of the measurement due to operator bias. The results of the proposed method are compared with results obtained by manual method. The results of proposed method are accurate and close to practical limits. The proposed method is easily repeatable, fast and economical and is expected to be useful in manufacturing of ductile cast iron and quality control practices.

References

Applications and in proceedings of NCRAIT, National Conf. on Recent Advances in Information Technology.

**Index Terms**

- Computer Science
- Image Processing

**Keywords**

- Fuzzy inference system
- Ductile iron
- Nodularity
- Image analysis
- Microstructure