



## Inverse Heat Transfer to Predict the Heat Transfer Coefficient for a Water Jet Impingement over a Flat Plate

Cheng-Chan Chien<sup>1</sup>, and Jiin-Yuh Jang<sup>2</sup>, and Yu-Feng Gan<sup>3</sup>, and Chine-Nan Lin<sup>4</sup>

*Department of Mechanical Engineering, National Cheng-Kung University, Tainan, Taiwan*

*1 E-mail address: d830214s@gmail.com , Tel: +886-62088573 2 E-mail address: jangjim@mail.ncku.edu.tw*

*3 E-mail address: N18043022@mail.ncku.edu.tw*

*4 E-mail address: lincn@mail.feu.edu.tw*

### Abstract

The purpose of the water jet impingement cooling is to improve the mechanical properties of the steel because the growth and the size of the grain and the flatness of the steel are controlled by the temperature distribution and the cooling rate of steel. Therefore, control cooling rate is the key technology in the rolling process to improve the mechanical properties.

This study investigates the heat transfer phenomena of the water jets impingement on a hot steel plate with different flow rate and spray-angle of the flat fan nozzle. The heat transfer coefficients for 2 different kind of flat fan nozzles and 3 different flow rates( 2.5L/min to 8 L/min) are calculated by the 3-D inverse heat transfer models solved by an algorithm developed with the conjugate-gradient method. The conjugate gradient method was an iterative method for solving a equation and used to optimize the heat transfer coefficient distribution. A test piece of steel plate was electrically heated from below heat pipe, its top surface was spray cooled and sides' heat transfer through natural convection. The spray was produced from a nozzle supplied with water from a pump and experimental temperature was measured by thermocouples connect to the data processor. The cooling rate and heat transfer effects will be discussed in detailed.

**Keywords:** conjugate gradient, water jet, inverse heat transfer