# The Measurement of Solar Differential Rotation from Proper Motion of Individual Sunspots

# Abstract

The differential rotation is the difference in the rate of rotation of each latitude in the Sun indicating that the Sun is not a solid body. The differential rotation is the result of the interaction between rotation and convection and causes dynamo circulation that affect the cycle of solar activity. Tracer method using features in the photosphere such as sunspots and magnetic fields is a method to measure the differential rotation. However, sunspots are easier to use as tracers because their intensity has a high contrast to the surroundings, easy to identify, and they have long lifetime. In this final project, 100 single sunspots on January 8-22, 2013 and August 25 - September 7, 2013 are used to measure the differential rotation of the Sun. In that time, the activity of the Sun in 24th solar cycle is high. The Sun's continuum images were obtained from HMI (Helioseismic Magnetic Imager) instrument at SDO (Solar Dynamic Observatory). Coordinate and area of sunspots are measured using ImageJ software and converted to Carrington coordinates. From the measurement, we derived the differential rotation equation, the relationship of velocity and area of sunspots, and the relation of sunspot’s velocity and Zurich classification.

Keywords: differential rotation of the Sun, sunspots, proper motion of sunspots.