3 Data Reduction

The relative position of binary is determined in terms of autocorrelation and boxcar process. Autocorrelation is used for the speckle images of binaries, and the spatial parameters are determined with normalized autocorrelation function to prevent override of bits limit of matrices. (Lewis, 1995)

Autocorrelation function is a very useful tool to enhance repeating signal in spatial domain. The repeating spatial information is enhanced by multiplying and sum process to $a(u,v)$ plane (equation 3-1).

$$a(u,v) = \sum_{x,y} f(x,y) f(x-u, y-v) \quad \ldots 3\text{-}1$$

For the calculated process, the error will be appeared if the number of data high than 32 bits, this error can be removed by normalized autocorrelation function, equation 3-2.

$$a_{norm}(u,v) = \frac{\sum_{x,y}\left[f(x,y) - \overline{f}_{u,v}\right]\left[f(x-u, y-v) - \overline{f}\right]}{\left\{\sum_{x,y}\left[f(x,y) - \overline{f}_{u,v}\right]^2 \sum_{x,y}\left[f(x-u, y-v) - \overline{f}\right]^2\right\}^{0.5}} \quad \ldots 3\text{-}2$$

where $\overline{f}$ is the mean of the feature and $\overline{f}_{u,v}$ is the mean of $f(x,y)$ in the region under the feature.

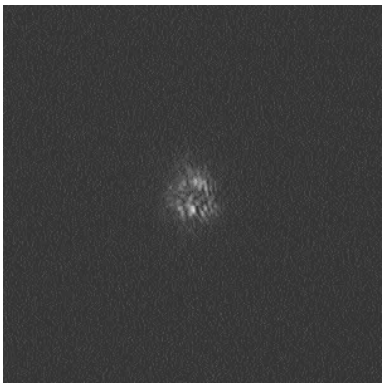

figure 3-1 One of the original images of WRH 12 taken from Philips 840K CCD.

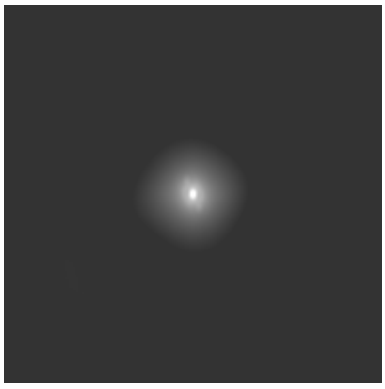

figure 3-2 The image of WRH 12 in terms of normalized autocorrelation processed.

Speckle images processed with the normalized autocorrelation is shown on the figure 3-2, and if it has any information of binary could be hidden on the sea of noise background. Because the signal of binary is very weak, Boxcar process is used as a filter to smooth the background to arise the signal if it existed. But the number of pixel for Boxcar process should be suitable, and 13*13 pixels as a mask is usually chosen. Let the b(x,y) respond the image of $a_{norm}(x,y)$ through Boxcar process, and then the final image is taken by following equation, 3-3.

$$o(x,y) = a_{norm}(x,y) - b(x,y) \qquad \ldots 3\text{-}3$$

Boxcar is used as a typical filter to enhance the signal to noise ratio, the final image for example of WRH 12 is shown on the figure 3-3.

figure 3-3 The final image of WRH12