Detection and Parameter Estimation

Table 1: Parameters for detection and parameter estimation.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modulation Frequency</td>
<td>0.25 MHz</td>
</tr>
<tr>
<td>IPP</td>
<td>205.87 Hz or 2750 ps</td>
</tr>
<tr>
<td>coherent integration time</td>
<td>0.24 seconds</td>
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</table>

The radar transmits with the 42m and receives with the 32m in a bi-static configuration. The radar beam crosses the debris ring twice per day, and although the transmit and receive nature of the radar allows for unobservable gaps in altitude, the resulting debris was mostly focused at an altitude close to 850 km, which is in the middle of one of the observable zones (700 to 1100 km range). Because of the large amount of data, the following process was used to trigger on detection. The raw signal is first put through a convolution with a trigger function and receive (absolute value) signal by the radar. The return signal is then processed through the maximum MF (Maximum Frequency) and the resulting signal is used for further analysis.

The maximum MF is shown in Figure 1. The maximum occurs in the middle of range 2, which corresponds to an altitude of 850 km.

The above equations and figures show the use of the match function to estimate where the debris is located and at what velocity it is traveling along the radar beam. The DOP (Doppler Parameter) calculation allows a much faster algorithm in this effort since one searches through the frequency space for the maximum rather than both range and frequency. A smaller frequency range can be specified, thus giving Doppler velocity directly. The RCS can then be calculated, and from there an estimate of the actual diameter of the debris using the Rayleigh approximation.

Data Analysis

Figure 4: Frequency profile of post-IPY data. The frequency profile is shown for both the IPP and the coherent integration time of 0.24 seconds.

Figure 5: Frequency profile of post-IPY data. The frequency profile is shown for both the IPP and the coherent integration time of 0.24 seconds.

Figure 6: Frequency profile of post-IPY data. The frequency profile is shown for both the IPP and the coherent integration time of 0.24 seconds.

Figure 7: Frequency profile of post-IPY data. The frequency profile is shown for both the IPP and the coherent integration time of 0.24 seconds.

Figure 8: Frequency profile of post-IPY data. The frequency profile is shown for both the IPP and the coherent integration time of 0.24 seconds.

Figure 9: Frequency profile of post-IPY data. The frequency profile is shown for both the IPP and the coherent integration time of 0.24 seconds.

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Figure 11: Frequency profile of post-IPY data. The frequency profile is shown for both the IPP and the coherent integration time of 0.24 seconds.

Figure 12: Frequency profile of post-IPY data. The frequency profile is shown for both the IPP and the coherent integration time of 0.24 seconds.

Figure 13: Frequency profile of post-IPY data. The frequency profile is shown for both the IPP and the coherent integration time of 0.24 seconds.

Figure 14: Frequency profile of post-IPY data. The frequency profile is shown for both the IPP and the coherent integration time of 0.24 seconds.

Figure 15: Frequency profile of post-IPY data. The frequency profile is shown for both the IPP and the coherent integration time of 0.24 seconds.

Figure 16: Frequency profile of post-IPY data. The frequency profile is shown for both the IPP and the coherent integration time of 0.24 seconds.

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Figure 18: Frequency profile of post-IPY data. The frequency profile is shown for both the IPP and the coherent integration time of 0.24 seconds.

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