Ring Diagram Pipeline

Status 11/5/2007

- Lead: Rick Bogart
- Team Members: S. Basu, D. Haber, B. Hindman, M.C. Rabello-Soares
- Task: Using ring-diagram analysis, produce time series of full-disc and synoptic tachograms and sound-speed perturbation maps from surface to depths of 30 Mm
- Input: Tracked tiles of HMI Doppler data, and possibly continuum intensity
Ring Diagram Pipeline

• Data Products
  • tiled mosaics of power spectra (intermediate)
    • hmi.LHV_tiled_5deg, hmi.LHV_tiled_10deg, hmi.LHV_tiled_30deg
  • tiled mosaics of power spectra fits
    • hmi.LHV_5deg_ringfits_dyn, hmi.LHV_15deg_ringfits_dyn, hmi.LHV_30deg_ringfits_dyn
    • hmi.LHV_5deg_ringfits_str, hmi.LHV_15deg_ringfits_str, hmi.LHV_30deg_ringfits_str
  • sub-surface flow maps
    • hmi.LHV_ssflow_disc_hr, hmi.LHV_ssflow_disc_mr, hmi.LHV_ssflow_disc_lr
Ring Diagram Pipeline

• Modules
  • pspec3 – 3-d power spectrum of surface-time data cube
  • ringfitf – “fast” fitting of ring diagram spectra for sub-surface flows
  • ringfitc – “comprehensive” fitting of ring diagram spectra for sub-surface structure
  • rdvinvrt – inversion for flows only
  • rdvsmooth – smoothing of flow inversions at different resolutions
  • rdsinvrt – inversion for thermal structure (and flows)
## Ring Diagram Data Products

<table>
<thead>
<tr>
<th>series</th>
<th>module</th>
<th>cadence (sec/rec)</th>
<th>size (MB/rec)</th>
<th>Tape</th>
<th>Retain (days)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>hmi.LHV_5deg_spectra</td>
<td>pspec3</td>
<td>12</td>
<td>23</td>
<td>No</td>
<td>55</td>
<td>mosaics of the power spectra of the tracked tiles in the series hmi.LHV_tiled_Ndeg, with 1-to-1 mapping of most parameters</td>
</tr>
<tr>
<td>hmi.LHV_15deg_spectra</td>
<td>pspec3</td>
<td>350</td>
<td>610</td>
<td>No</td>
<td>55</td>
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<tr>
<td>hmi.LHV_30deg_spectra</td>
<td>pspec3</td>
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<td>4900</td>
<td>No</td>
<td>55</td>
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<tr>
<td>hmi.LHV_5deg_ringfits_dyn</td>
<td>ringfitf</td>
<td>12</td>
<td>0.5</td>
<td>No</td>
<td>275</td>
<td>mosaics of the &quot;fast&quot; (&quot;dynamics&quot;) fits to the power spectra in series hmi.LHV_Ndeg_spectra</td>
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<tr>
<td>hmi.LHV_15deg_ringfits_dyn</td>
<td>ringfitf</td>
<td>350</td>
<td>0.5</td>
<td>No</td>
<td>275</td>
<td></td>
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<tr>
<td>hmi.LHV_30deg_ringfits_dyn</td>
<td>ringfitf</td>
<td>2800</td>
<td>0.5</td>
<td>No</td>
<td>275</td>
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<th>Tape</th>
<th>Retain (days)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>hmi.LHV_ssflow_disc_hr</td>
<td>rdinvrt</td>
<td>32700</td>
<td>0.2</td>
<td>Yes</td>
<td>1825</td>
<td>full-disc maps of the sub-surface flows at high, medium, and low spatial resolution, at 4, 10, and 16 depths respectively; inferred from inversion of the ring-diagram spectral fits in series hmi.LHV_Ndeg_ringfits_dyn and smoothing</td>
</tr>
<tr>
<td>hmi.LHV_ssflow_disc_mr</td>
<td>rdinvrt, rdvsmooth</td>
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<td>0.05</td>
<td>Yes</td>
<td>1825</td>
<td>Mission Data Products</td>
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<tr>
<td>hmi.LHV_ssflow_disc_lr</td>
<td>rdinvrt, rdvsmooth</td>
<td>196200</td>
<td>0.015</td>
<td>Yes</td>
<td>1825</td>
<td></td>
</tr>
<tr>
<td>hmi.LHV_5deg_ringfits_str</td>
<td>ringfitc</td>
<td>12</td>
<td>1</td>
<td>Yes</td>
<td>275</td>
<td>mosaics of the &quot;comprehensive&quot; (&quot;structure&quot;) fits to the power spectra in series hmi.LHV_Ndeg_spectra</td>
</tr>
<tr>
<td>hmi.LHV_15deg_ringfits_str</td>
<td>ringfitc</td>
<td>350</td>
<td>1</td>
<td>Yes</td>
<td>275</td>
<td></td>
</tr>
<tr>
<td>hmi.LHV_30deg_ringfits_str</td>
<td>ringfitc</td>
<td>2800</td>
<td>1</td>
<td>Yes</td>
<td>275</td>
<td></td>
</tr>
</tbody>
</table>
Ring Diagram Pipeline

Modules

\textit{pspec3} DRMS port of SOI module \textit{powrspec3}; needs to use new FFT library

\textit{ringfitf} Port of outside code (D. Haber); needs some development

\textit{ringfitc} Port of SOI module \textit{ringfit}; needs development

\textit{rdvinvrt} Port of outside code (D. Haber); needs some development

\textit{rdvsmooth} New code

\textit{rdsinvrt} Port of outside code (S. Basu); needs development
Ring Diagram Pipeline

Status
– pipeline plan well-defined, except for production of thermal structure products
– porting of module codes has only just begun
– need test data
– need schedule

Concerns
– CPU requirements poorly known, could be substantial
– some module codes need substantial development
– may need to analyse intensity as well as Doppler signal for data near limb