Combined MPDA/SZ-2 Volume Coverage Pattern to Mitigate Range Folding:
Informational Briefing to Technical Advisory Committee

Radar Operations Center
Applications Branch
David Zittel
1 November 2006
Outline

• Rationale for a combined SZ-2 and Multiple PRF Dealiasing Algorithm (MPDA)
• Description of test VCP 122
• Summary of cases
• Examples
  – Comparison to other VCPs
  – Two vs. three Doppler scans
• Preliminary conclusions
• Build 10 key dates
• Work yet to be done
Rationale for Combining SZ-2 with MPDA

• MPDA
  – Works well out to 175 km which is end of first trip for its slowest PRF
  – Ability to range unfold beyond 175 km is sporadic and susceptible to velocity dealiasing errors

• SZ-2
  – Provides good coverage at long ranges
  – A residual band of range folded signal *may* extend up to 30 km from end of 1st trip

• Combining the two techniques mitigates the weakness of each

• SZ-2 is ORDA based; MPDA is RPG based
  – Runs sequentially
Description of Test VCP 122

• Uses same 9 elevation angles as VCPs 21 and 121
• Uses MPDA scan strategy
  – Combines up to three Doppler scans at the same elevation angle using different PRFs (unambiguous ranges 117, 137, & 175 km) to reduce range folding and improve velocity dealiasing
  – 20 cuts total
• Uses SZ-2 processing for the surveillance and 1st Doppler scan at 0.5 and 1.45 deg
• Takes about 16 more seconds to complete than VCP 121
# VCP 122 Split Cuts

**VOLUME COVERAGE PATTERN 122 (MPDA/SZ-2 with VCP 21 elev. angles)**

**SCAN STRATEGY MPDA**  
**SHORT PULSE**

<table>
<thead>
<tr>
<th>Elevation (deg)</th>
<th>AZ Rate (deg/sec)</th>
<th>Period (sec)</th>
<th>WF Type</th>
<th>PRF No.</th>
<th>No Pulses</th>
<th>4 No. Pulses</th>
<th>5 No. Pulses</th>
<th>6 No. Pulses</th>
<th>7 No. Pulses</th>
<th>8 No. Pulses</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>18.675</td>
<td>19.38</td>
<td>CS/SZ2</td>
<td>1</td>
<td>17</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>0.5</td>
<td>19.754</td>
<td>18.22</td>
<td>CD/SZ2</td>
<td>8</td>
<td>-</td>
<td>43</td>
<td>50</td>
<td>55</td>
<td>59</td>
<td>64</td>
</tr>
<tr>
<td>0.5</td>
<td>27.400</td>
<td>13.14</td>
<td>CD</td>
<td>6</td>
<td>-</td>
<td>31</td>
<td>37</td>
<td>40</td>
<td>43</td>
<td>46</td>
</tr>
<tr>
<td>0.5</td>
<td>21.402</td>
<td>16.82</td>
<td>CD</td>
<td>4</td>
<td>-</td>
<td>40</td>
<td>47</td>
<td>51</td>
<td>55</td>
<td>59</td>
</tr>
<tr>
<td>1.45</td>
<td>19.842</td>
<td>18.68</td>
<td>CS/SZ2</td>
<td>1</td>
<td>16</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1.45</td>
<td>19.754</td>
<td>18.22</td>
<td>CD/SZ2</td>
<td>8</td>
<td>-</td>
<td>43</td>
<td>50</td>
<td>55</td>
<td>59</td>
<td>64</td>
</tr>
<tr>
<td>1.45</td>
<td>27.400</td>
<td>13.14</td>
<td>CD</td>
<td>6</td>
<td>-</td>
<td>31</td>
<td>37</td>
<td>40</td>
<td>43</td>
<td>46</td>
</tr>
<tr>
<td>1.45</td>
<td>21.402</td>
<td>16.82</td>
<td>CD</td>
<td>4</td>
<td>-</td>
<td>40</td>
<td>47</td>
<td>51</td>
<td>55</td>
<td>59</td>
</tr>
</tbody>
</table>
## VCP 122 Upper Cuts

<table>
<thead>
<tr>
<th>Elevation (deg)</th>
<th>Scan</th>
<th>PRF No.</th>
<th>No Pulses</th>
<th>4 No. Pulses</th>
<th>5 No. Pulses</th>
<th>6 No. Pulses</th>
<th>7 No. Pulses</th>
<th>8 No. Pulses</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.4</td>
<td>B</td>
<td>1,8</td>
<td>6</td>
<td>27</td>
<td>32</td>
<td>34</td>
<td>37</td>
<td>40</td>
</tr>
<tr>
<td>2.4</td>
<td>CD</td>
<td>6</td>
<td>-</td>
<td>31</td>
<td>37</td>
<td>-</td>
<td>40</td>
<td>43</td>
</tr>
<tr>
<td>2.4</td>
<td>CD</td>
<td>4</td>
<td>-</td>
<td>40</td>
<td>47</td>
<td>51</td>
<td>55</td>
<td>59</td>
</tr>
<tr>
<td>3.35</td>
<td>B</td>
<td>2,8</td>
<td>6</td>
<td>28</td>
<td>33</td>
<td>35</td>
<td>38</td>
<td>40</td>
</tr>
<tr>
<td>3.35</td>
<td>CD</td>
<td>6</td>
<td>-</td>
<td>31</td>
<td>37</td>
<td>-</td>
<td>40</td>
<td>43</td>
</tr>
<tr>
<td>3.35</td>
<td>CD</td>
<td>4</td>
<td>-</td>
<td>40</td>
<td>47</td>
<td>51</td>
<td>55</td>
<td>59</td>
</tr>
<tr>
<td>4.3</td>
<td>B</td>
<td>2,4</td>
<td>6</td>
<td>40</td>
<td>48</td>
<td>52</td>
<td>56</td>
<td>61</td>
</tr>
<tr>
<td>4.3</td>
<td>CD</td>
<td>7</td>
<td>-</td>
<td>29</td>
<td>34</td>
<td>37</td>
<td>-</td>
<td>40</td>
</tr>
<tr>
<td>6.0</td>
<td>B</td>
<td>3,5</td>
<td>6</td>
<td>34</td>
<td>40</td>
<td>43</td>
<td>47</td>
<td>51</td>
</tr>
<tr>
<td>9.9</td>
<td>CD</td>
<td>7</td>
<td>-</td>
<td>28</td>
<td>34</td>
<td>37</td>
<td>-</td>
<td>40</td>
</tr>
<tr>
<td>14.6</td>
<td>CD</td>
<td>8</td>
<td>-</td>
<td>28</td>
<td>33</td>
<td>36</td>
<td>39</td>
<td>-</td>
</tr>
<tr>
<td>19.5</td>
<td>CD</td>
<td>8</td>
<td>-</td>
<td>28</td>
<td>33</td>
<td>36</td>
<td>39</td>
<td>-</td>
</tr>
</tbody>
</table>
Summary of Test Cases

• 9-10 October 2006
  – ~24 hours
  – Widespread rain across central Oklahoma

• 15-16 October 2006
  – ~28 hours
  – Widespread heavy rain south and central Oklahoma
9 October 2006
20:20 to 20:57Z
Comparison of Test VCP 122 with MPDA VCP 121; SZ-2 VCPs 211, 212, 221; and Legacy VCP 12
20:26Z Test VCP 122

20:31Z SZ-2 VCP 211
20:36Z SZ-2 VCP 212

20:41Z SZ-2 VCP 221
20:51Z Test VCP 122

20:47Z Legacy VCP 12

TAC briefing 1 Nov 2006 on test VCP 122
Velocity/Range-folded Area for Various VCPs
9 October 2006, 20:15Z to 20:57Z, Elev. 0.5 Deg.
Velocity/Range-folded Area for Various VCPs
9 October 2006, 20:15Z to 20:57Z, Elev. 0.5 Deg.
Reflectivity, 16 October 2006, 12:02Z, Elev. 0.5
Test VCP 122 w/PRF6 Omitted

16 Oct 06 12:02Z
Elev 1.45

SZ-2 w/PRF8
Area of Velocity & Range-Folded Signal
15 October 2006, 11:53Z to 12:55Z, 12-Volume Average

<table>
<thead>
<tr>
<th></th>
<th>Area (sq km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCP 122</td>
<td>121,878.9</td>
</tr>
<tr>
<td>VCP 122 w/PRF8&amp;4</td>
<td>121,107.7</td>
</tr>
<tr>
<td>SZ-2 w/PRF8</td>
<td>111,337.1</td>
</tr>
</tbody>
</table>

TAC briefing 1 Nov 2006 on test VCP 122
Preliminary Conclusions

- VCP 122 outperforms either MPDA VCP 121 or SZ-2 VCPs 211, 212, and 221 in reducing range folding
  - Less than half residual range folding left in by SZ-2 VCPs
- May be able to omit one Doppler scan from MPDA VCP 121 at 0.5 and 1.45 degrees
  - Would cut 26+ seconds from volume scan time
- ORDA data quality team recommends modifying VCP 121 to meet Build 10 Design & Development deadline
Build 10 Key Dates

• 26 Jun 2006 to 30 Mar 2007 Design & Development
• 27 Jan 2007 RPG Integration starts
• 28 Jun 2007 System testing starts
• 23 Oct 2007 Operations testing starts
• 10 Jan 2008 Beta testing starts
• 14 Apr 2008 Deployment
Work to be Accomplished by 30 March 2007

• Submit configuration change request
• Collect more data sets ~10-12 cases, 3-4 hours per case
• Evaluate two vs. three Doppler scans
  – If two is selected, coordinate with other users if needed
• Complete statistical analyses on the cases
• Update TAC if requested to