CNI User Meeting Agenda

Sep. 6, 2019

- Upgrade System
- Upgrade Timeline
- System Comparison Plans and Preliminary Results
- CNI Support for Users at the Lucas Center
- Scheduling Accommodations
- User Discussion
Upgrade System Options

SIGNA PREMIER
(Lucas 3T2)

Discovery MR750
Connectome Plus Edition
(UHP 3T)
<table>
<thead>
<tr>
<th>Specification</th>
<th>Discovery MR750</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bore Diameter</td>
<td>60cm</td>
</tr>
<tr>
<td>Peak Gradient*</td>
<td>50 mT/m</td>
</tr>
<tr>
<td>Peak Slew**</td>
<td>200 mT/m/ms</td>
</tr>
<tr>
<td>Rx Channels</td>
<td>32</td>
</tr>
<tr>
<td>Comment</td>
<td>Current CNI System</td>
</tr>
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</table>

*Peak gradient that is sustainable. Systems may have higher gradient strength, but only for limited duty cycle.

**Peak slew rate generally limited to 150 mT/m/ms for whole-body systems.
## Upgrade System Options

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<th>SIGNA Premier</th>
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<td>Bore Diameter</td>
<td>60cm</td>
<td>70cm</td>
</tr>
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<td>50 mT/m</td>
<td>70 (80) mT/m</td>
</tr>
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<td>Peak Slew**</td>
<td>200 mT/m/ms</td>
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</tr>
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<td>32</td>
<td>140</td>
</tr>
<tr>
<td>Comment</td>
<td>Current CNI System</td>
<td>Main product roadmap</td>
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## Upgrade System Options

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<tr>
<th>Specification</th>
<th>Discovery MR750</th>
<th>SIGNA Premier</th>
<th>Discovery MR750 UHP</th>
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</thead>
<tbody>
<tr>
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<td>60cm</td>
<td>70cm</td>
<td>60cm</td>
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<td>50 mT/m</td>
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</tr>
<tr>
<td>Peak Slew**</td>
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<td>200 mT/m/ms</td>
<td>250 mT/m/ms</td>
</tr>
<tr>
<td>Rx Channels</td>
<td>32</td>
<td>140</td>
<td>64</td>
</tr>
<tr>
<td>Comment</td>
<td>Current CNI System</td>
<td>Main product roadmap</td>
<td>Very stiff coil (7T)-minimal vibration</td>
</tr>
</tbody>
</table>

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UHP System

• UHP 3T system
  – New HRMB gradient coil developed for 7T system
  – Single 3T installation at Duke (Allen Song)
  – Lucas, UCSD, Michigan, Sunnybrook, others have expressed interest or plans to install
  – Same electronics as Premier, 60-cm bore
  – Improved gradients: 100 mT/m, 250 mT/m/ms
  – Gradient heating limits not an issue as they are with Premier
- Receive arrays & shim coils
  - Additional 3rd-order shim coils -- 10 HOS coils in total
  - Will receive “NFL” 48-channel head coil and multipurpose surface AIR coils
  - Existing coils will continue to work
- New software features
  - Machine-learning assisted automatic prescription
  - New efficient quantitative MRI methods
  - High-resolution multishot diffusion methods
### Upgrade Timeline

**CNI Upgrade**

<table>
<thead>
<tr>
<th>Task</th>
<th>Start</th>
<th>End</th>
</tr>
</thead>
<tbody>
<tr>
<td>UHP Installation</td>
<td>1/6/20</td>
<td>1/7/20</td>
</tr>
<tr>
<td>CNI Uninstall</td>
<td>1/8/20</td>
<td>1/8/20</td>
</tr>
<tr>
<td>Magnet Rampdown</td>
<td>1/8/20</td>
<td>1/10/20</td>
</tr>
<tr>
<td>Deinstall of 750</td>
<td>1/13/20</td>
<td>1/17/20</td>
</tr>
<tr>
<td>RF Shield Test</td>
<td>1/20/20</td>
<td>1/21/20</td>
</tr>
<tr>
<td>New Coil Install</td>
<td>1/21/20</td>
<td>1/24/20</td>
</tr>
<tr>
<td>New Cabinet &amp; Cable Install</td>
<td>1/27/20</td>
<td>2/4/20</td>
</tr>
<tr>
<td>RF Shield Test</td>
<td>2/4/20</td>
<td>2/5/20</td>
</tr>
<tr>
<td>System Calibrations</td>
<td>2/6/20</td>
<td>2/21/20</td>
</tr>
<tr>
<td>CNI Install &amp; Test</td>
<td>2/24/20</td>
<td>2/28/20</td>
</tr>
</tbody>
</table>

- Infrastructure (electrical & water) upgrades already begun
- Main installation to begin 1/6/2020 – complete 2/28/2020
- CNI facility largely unavailable during that period
• Developing system comparison methods using CNI/Lucas systems as testbed
  – Receiver noise quantification
  – Temporal SNR maps on fBIRN phantom
  – FA comparison of travelling subject
  – TBD rsFMRI comparison of travelling subject
  – TBD task FMRI comparison of travelling subject
  – CNI staff will travel to Waukesha to test 3T UHP in October
Receiver Noise Quantification

- Receive channel coupling degrades parallel imaging performance
- Noise test acquires data with no RF transmit (e.g. zero signal)
- Compare noise measurements between channels
- Ideal situation is zero correlation between different channels
Receiver noise quantification

Noise Covariance Matrix

CNI Nova 32ch

3T3 Nova 32ch

Largest 4 Components

• Absolute noise levels are similar (not shown in the figure)

• Slightly higher covariance between channels in 3T3 Nova coil (note the 4th trace)
SMS EPI tSNR comparison

Axial

single band  SMS 3  SMS 4  SMS 6  SMS 8

CNI

3T3

Axial Rx, Axial slice, 2.5mm iso, 15s/30ms TR/TE, 50 reps
SMS EPI tSNR comparison

Axial Rx, Sagittal slice, 2.5mm iso, 15s/30ms TR/TE, 50 reps
Support for Users at Lucas

• User access to Lucas Center
  • Unfortunately no shortcuts for CNI users
  • See http://med.stanford.edu/lucasmri/new-users.html
• IRB modification to include Lucas Center
  — A new IRB is not required – a previous IRB may be modified to include the Lucas Center in the list of resources
  — Note that as animals are studied at Lucas, additional language is required to describe safety procedures and is available on Lucas website
• SMS sequences are available on 3T3, and working on adding SMS reconstruction gear to lucascenter.Flywheel.io
• CNI can help in transferring protocols
• CNI setting up mechanism for automatic data transfer to cni.Flywheel.io
Scheduling Accommodations

- Special exceptions for booking outside the 8-week window is always possible by emailing Laima
- Longitudinal studies with strict time requirements on followup scans may want to book ahead or take advantage of the "CNI Short Term Reserve Time"
- Labs will be allowed to book up to 4 hours of additional protocol development time to familiarize themselves with the new system
Help Maintain a Productive Environment

• Please stay on time
• Please return all supplies & equipment as necessary so they are ready for the next user
• We all enjoy a nice facility – please keep it looking that way by cleaning up
• Please help us to ensure good data quality
  – Please review your data in a timely fashion
  – Regular QA scans cannot capture all system problems / errors
  – Let us know of any problems as soon as possible
Questions? / Discussion