SP8 New Electronics
*Benefits for applications*

**Marco Meijering**
Application Manager CLSM, Life Science Division.
The New SP8 Electronics

- linear scan with 85% duty cycle
- in unidirectional mode: asymmetrical linear scan
- for conventional scanner linear and sine
- resonant scanner always moves sinusoidal
- increased bandwidth: more channels @ formats
New Leica Electronics - Specifications

• LAS X => 3.5.0 supports linear scanning with maximum duty cycles of 85%
  • - Uni-directional linear scan from 1Hz to 1800Hz
  • - Bi-directional scan from 1Hz to 600Hz

• Linearization of resonant Galvo?
  The nature of a resonant oscillation is basically a sinusoidal movement.
  We are not going to move the resonant galvos linearly!

starting with S/N 8110xxxxxx
New Leica Electronics - Specifications

- more computation power
- faster:
  - 80MHz analog-digital conversion
  - => max 1664 Pixel/line @12kHz
  - => max 2496 Pixel/line @8kHz
- more channels simultaneously
  e.g. 4 HyD + 3 PMT, bidir, 512x512 @8kHz

- Examples for increased bandwidth:

<table>
<thead>
<tr>
<th>New Electronics</th>
<th>Previous Electronics</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 8kHz: 2496x2496, 3 ch, 8-bit simultaneous</td>
<td>• 8kHz: 1248x1248, 2 ch, 8-bit simultaneous</td>
</tr>
<tr>
<td>• 8kHz: 2496x2496, 1 ch, 16-bit</td>
<td>• 8kHz: 1248x1248, 12-bit</td>
</tr>
<tr>
<td>• 12kHz: 1664x1664, 3 ch, 8-bit simultaneous</td>
<td>• 12kHz: 832x832, 2 ch, 8-bit simultaneous</td>
</tr>
<tr>
<td>• 12kHz: 1664x1664, 1 ch, 16-bit</td>
<td>• 12kHz: 832x832, 12-bit</td>
</tr>
<tr>
<td>• 12kHz: 1024x1024, 4 ch, 8-bit simultaneous</td>
<td>• 12kHz: 416x416, 4 ch, 8-bit simultaneous</td>
</tr>
<tr>
<td>• 12kHz: 1024x1024, 2 ch, 8-bit, bi-directional simultaneous</td>
<td>• 12kHz: 832x832, 2 ch, bi-directional simultaneous</td>
</tr>
</tbody>
</table>
Movement of Line-Galvanometer

Comparison sinusoidal and linear
YES,

there is a new check-box!
YES, WE CAN!

85% Duty Cycle for bidirectional scanning!
Unidirectional Scanning:

Duty Cycle only 42.5%?
Unidirectional Scanning:

New Leica Unidirectional Asymmetric Linear Scan

> 80% Duty Cycle for unidirectional scanning < 200Hz
> 60% Duty Cycle for unidirectional scanning < 400Hz
Unidirectional Scanning:

linearized scan:
2.5 times more signal, 2.5 brighter in counting mode, 58% more S/N
Typical Pixel Dwell Times 400Hz @ 512x512

- Sinusoidal: 1.21 µs
- Linearized bidirectional: 1.96 µs (x 1.6)
- Linearized unidirectional: 3.05 µs (x 2.5)

Position vs. Time diagram:
- Red line: Sinusoidal
- Blue line: Linearized bidirectional
- Orange line: Linearized unidirectional
Short Guide
Benefits from Linear Scan to SP8 portfolio

- 200 Hz scan speed – linear vs sine
- Enjoy 58% SNR increase at higher irradiation dose

- Keep same SNR – 440 Hz (linear) vs 200 Hz (sine) scan speed advantage
- Enjoy higher frame rate at same SNR and irradiation dose (faster time lapse and stacks)

Advantage for techniques which are gasping for SNR and/or SPEED
Linearized scan offers three different possibilities:

1) **Brighter image or better SNR**
   Stay at the same frame rate (lines in Hz) and laser power, pixel dwell time is increased:
   Enjoy brighter image in HyD photoncounting mode or better SNR in HyD standard mode and PMT.

2) **Less laser power**
   Stay at the same frame rate (lines in Hz) and same pixel dwell time, means same brightness or SNR, respectively:
   Apply less laser power

3) **Higher frame rate**
   Stay at the same pixel dwell time, means same brightness or SNR, respectively and same laser power:
   Enjoy higher frame rate (lines in Hz)
Thank You!