OMERO Implementation at Imperial College London

- **Installation, technical solutions, data integration**: Bioinformatics Support Service (Mark Woodbridge, Chris Tomlinson)

- **Testing & Users**: Facility for Imaging by Light Microscopy (FILM) (Martin Spitaler, Christian Liebig, Steve Rothery), facility users, some non-facility users

- **Time scale**:
  - first test installation: April 2008
  - large-scale import test and feedback: June 2009
  - first tests with live data: December 2009
  - general roll-out to facility users: from January 2010
Deployment Strategy

• Extensive research
  – Hardware
  – Formats

• Working relationship
  – IT
  – Bioinformatics
  – Imaging

• Candidate Users/Projects
  – Scale
  – Formats

• Expansion
  – Infrastructure
  – Support
Deployment Issues

- Software upgrades
  - Planning and testing
  - Web Start
- Authentication
  - SSL
  - Directory
  - SSO
- Data in/out
  - Formats
  - Metadata
  - Archival (and integrity)
  - Access
- Onboarding
  - Scalability
  - Tutorials
Ongoing Work

• Data management
  – Experimental workflows
  – Long-term storage
• Software pipelines
• Server-side processing
• Institutional integration
OMERO/XperimentR (Assay)
OMERO/XperimentR (Repository)
### OMERO/XperimentR (Metadata)

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>29.05.07 raw_Series027.tif</td>
</tr>
<tr>
<td>Image date</td>
<td>2007 06 19 08:10:43</td>
</tr>
<tr>
<td>Dimensions (XY) [px]</td>
<td>1024 x 1024</td>
</tr>
<tr>
<td>Pixel size (XYZ) [μm]</td>
<td>352.77777 x 352.77777 x 0.0</td>
</tr>
<tr>
<td>Z-sections</td>
<td>1</td>
</tr>
<tr>
<td>Timepoints</td>
<td>1</td>
</tr>
</tbody>
</table>
User overview

- Omero users:
  - FILM:
    - facility staff: microscope tests, user projects
    - researchers currently using OMERO: ~15
    - (potential users: ~380 individual microscopists / ~120 groups)
  - outside FILM:
    - EM (OMERO trial)
    - Photonics (fast Flim, OMERO trial)

- research areas: cell biology, developmental biology, immunology, infection biology, physiology, stem cell research, biological engineering

- methodologies: widefield, confocal, two-photon (in vivo), Flim, TIRF, PALM / STORM (in development), high-throughput screening
Microscope overview, file formats

- Widefield:
  - Zeiss Axiovert 200M with Hamamatsu HCImage (*.TIFF, *.CXD) and Perkin Elmer Volocity (Volocity database format)
- Confocal:
  - Zeiss LSM-510 (*.LSM)
  - Leica SP-2 (TIFF, *.LEI)
  - Leica-SP5 (LIF)
- Flim:
  - Becker-Hickel (*.SPC)
- HTS:
  - Cellomics (*.C01)
## User experience - file formats

<table>
<thead>
<tr>
<th>File type</th>
<th>Pixel data</th>
<th>Meta data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hamamatsu HCImage (*.TIFF, *.CXD)</td>
<td>yes</td>
<td>partially</td>
</tr>
<tr>
<td>Perkin Elmer Volocity (Volocity database format)</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Zeiss LSM</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Leica SP2 LEI</td>
<td>yes (mostly)</td>
<td>most</td>
</tr>
<tr>
<td>Leica SP5 LIF</td>
<td>yes (mostly)</td>
<td>most</td>
</tr>
<tr>
<td>Becker-Hickl SPC</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Cellomics</td>
<td>not tested</td>
<td>not tested</td>
</tr>
</tbody>
</table>
Remaining issues:

- **Hamamatsu HCImage (*.TIFF, *.CXD):**
  - XYZT not supported
  - channel information, exposure time, gain, … not detected (time course is detected)
  - metadata are imported in raw format, but not interpreted

- **Volocity:**
  - not supported, indirect via OME-TIFF not possible, apparently due to an export fault

- **Leica SP2 LEI:**
  - lambda-scan imported, but as a time series (metadata not correct)
  - import ‘unstable’

- **Leica SP5 LIF:**
  - lambda-scan as for LEI
  - MP laser settings not detected

- **Becker-Hickl SPC:**
  - not supported
User experience - usability

• the core functionality of OMERO is seen as extremely useful:
  • central repository of data from various microscopes
  • easy visualisation
  • easy access from any location
  • sharing (but too limited for routine usage)
  • quick access to archived data and OME-TIFF

• visualisation:
  • generally good, many good features (split screen, copy / paste rendering settings, greyscale,
  • rendering limitations limit its usability (visualisation is not quantitative, due to autocontrast, positive and negative controls appear with equal brightness)
  • the problem of side-by-side visualisation of many images is unsolved:
    • zoom too small in thumbnail view
    • split / greyscale visualisation not available

• data archiving:
  • in principle great solution for central data archiving
  • main problem: unreliable archiving (easy to forget archive tick box, not option to set it by default)
  • following from this, data duplication (local storage is preferred)
Wish list

**Metadata:**
- support for missing formats
- confocals: pinhole size as Airy Units (in addition to micrometer)

**Data storage:**
- it should be possible to make archiving non-optional in the preferences (or by administrator)
- when deleting data, the original image data should be deleted (or quarantined)

**Usability:**
- rendering!
  - option to turn it off by default throughout
  - must accept values outside min / max pixel values
- UNDO functions
- user preferences:
  - screen layout
  - default rendering / visualisation (e.g. min / max, greyscale, split, …)
  - data archiving on

**Sharing:**
- sharing via INSIGHT
- access to archived file via sharing and / or export as OME-TIFF
- hierarchy preserved in shared files (sharing of whole folder / experiments)
Future plans

**Improving implementation:**
- improved integration in lab workflow (annotation / sharing)
- final data storage solution

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**Improving data quality:**
- annotation with (compulsory?) experimental metadata on upload
- integration with other data (Systems Biology)

**Improving usability:**
- integration with image analysis (Definiens, CellProfiler):
  - software should read image data from OMERO, analyse them and write data back into OMERO, together with analysis protocols (logs) and results
  - raw data, analysis logs and results should be automatically linked in OMERO
  - ideally, all data should be visualised in easily accessible form (e.g. multiwell plate layout)
Cooperations - THANKS

• FILM staff: Christian Liebig (now Tübingen), Steve Rothery, Mark Scott
• Bioinformatics Support Service: Mark Woodbridge, Chris Tomlinson, Sarah Butcher
• OMERO team Dundee: Jason Swedlow, Will Moore, …
• Our patient users, first and foremost Marek Cebecauer (Imperial College / University Prague)
• Hamamatsu support, Leica engineers, Definiens Support