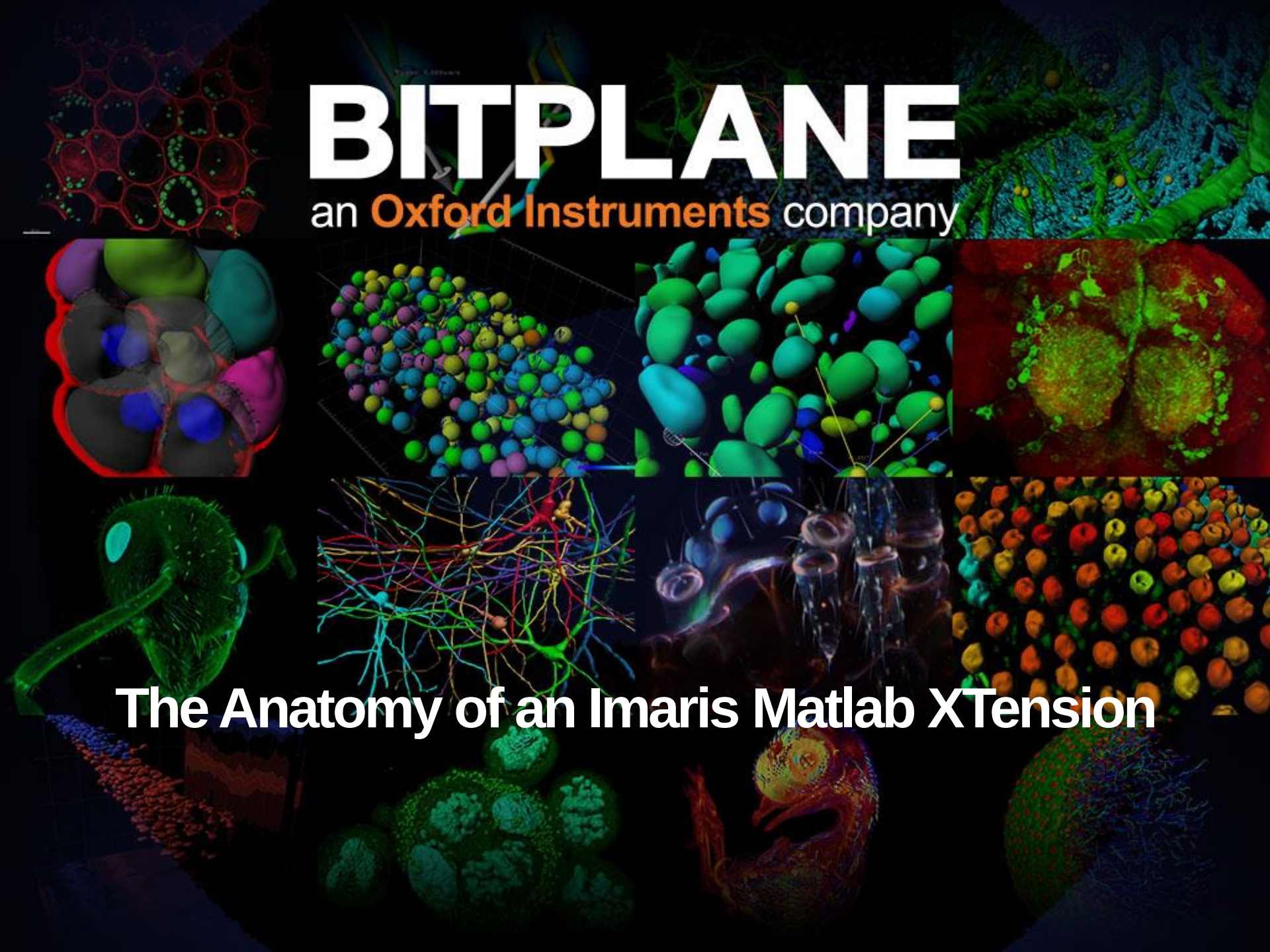
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The Anatomy of an Imaris Matlab XTension

Imaris XT: Documentation for Programming

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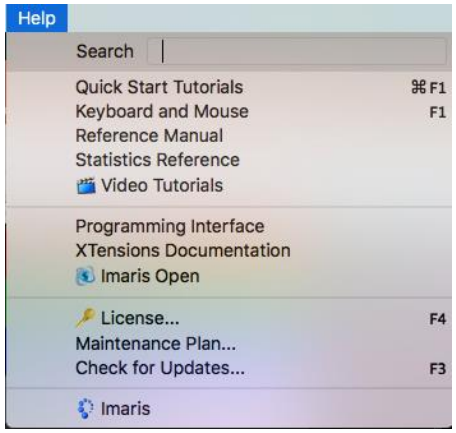

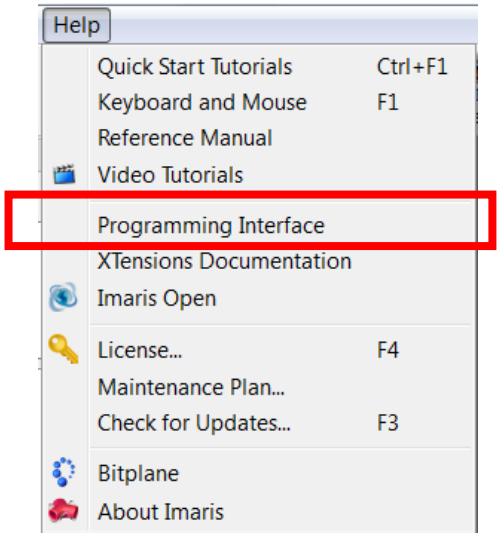

Introduction to Imaris Interface

Connect to Imaris in Java

To connect to an **Imaris** instance, it is first necessary to connect to the ImarisServer::IServer at port 4029 using ICE. The package Ice is included in Ice.jar. The package ImarisServer is generated compiling bpImarisServerIce.ice.

Example in Java:

```
ImarisServer.IServerPrx GetServer() {
  Ice.Communicator vCommunicator = Ice.Util.initialize();
  Ice.ObjectPrx vObject = mCommunicator.stringToProxy("ImarisServer:default -p 4029");
  ImarisServer.IServerPrx vServer = ImarisServer.IServerPrxHelper.checkedCast(vObject);
  return vServer;
}
```

Connect to Imaris in Matlab

The code shown to connect to **Imaris** in Java is provided as a utility in ImarisLib.jar (this file is located in imaris_installation_folder/XT/matlab). This jar file can be used to connect to **Imaris** from Matlab, that does not directly supports ICE.

Example in Matlab:

```
function aImarisApplication = GetImaris
javaaddpath ImarisLib.jar;
vImarisLib = ImarisLib;
vObjectId = 0; % this might be replaced by "vObjectId = <a name=getobjectid><b>GetObjectId</b></a>" (see later)
aImarisApplication = vImarisLib.GetApplication(vObjectId);
```

As the first **Imaris** instance that registers itself to the Server is assigned to ID zero, an aObjectId equal to zero will work in most of the cases. ImarisLib.jar grants access to the Server; this can be useful in case of multiple instances of **Imaris** are started.

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Simple XTension Workflow

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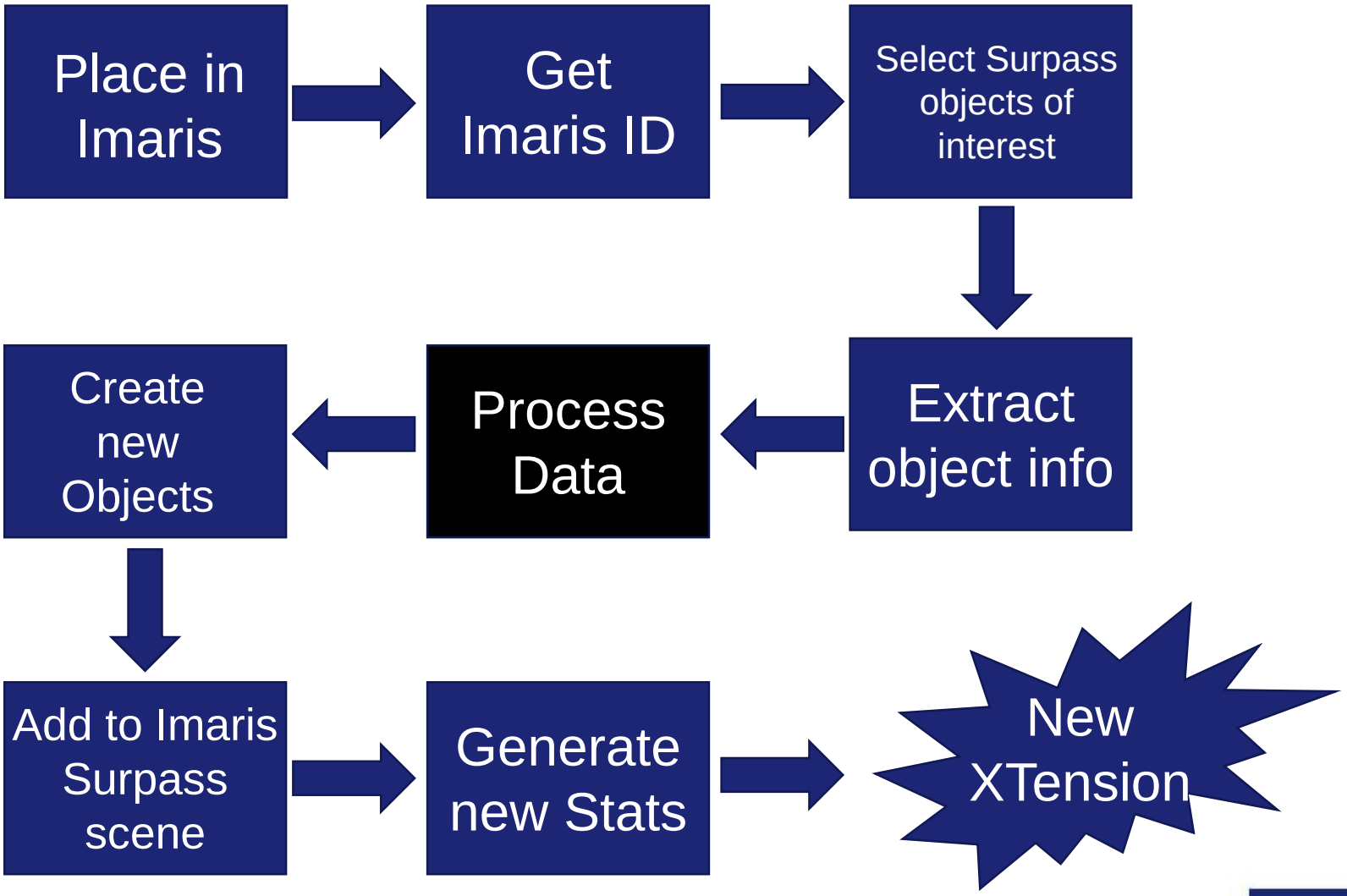

Populating XTensions in Imaris

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Inserts XT option in the ‘surfaces function’ folder in the Image Processing menu tab

Inserts XT option in the Surpass scene (Gear tab)

```
%<CustomTools>
%      <Menu>
%       <Submenu name="Surfaces Functions">
%        <Item name="BiofilmAnalysis" icon="Matlab">
%          <Command>MatlabXT::XT_MJG_BiofilmAnalysis_Complete(%i)</Command>
%        </Item>
%       </Submenu>
%      </Menu>
%      <SurpassTab>
%        <SurpassComponent name="bpSurfaces">
%          <Item name="BiofilmAnalysis" icon="Matlab">
%            <Command>MatlabXT::XT_MJG_BiofilmAnalysis_Complete(%i)</Command>
%          </Item>
%        </SurpassComponent>
%      </SurpassTab>
%    </CustomTools>
```

- Inserting for other Surpass objects (GearTab)
  - bpSpots
  - bpFilaments
  - bpCells
- One XTension can be added to more than one Surpass Object (See Distance Transform)
- These are always commented out of code with “%” in Matlab

Starting an XTension

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- Initiating the connection between Matlab and a specific Imaris instance

```
function XTSpotsCloseToSurface(aImarisApplicationID)

% connect to Imaris interface
if ~isa(aImarisApplicationID, 'Imaris.IApplicationPrxHelper')
    javaaddpath ImarisLib.jar
    vImarisLib = ImarisLib;
    if ischar(aImarisApplicationID)
        aImarisApplicationID = round(str2double(aImarisApplicationID));
    end
    vImarisApplication = vImarisLib.GetApplication(aImarisApplicationID);
else
    vImarisApplication = aImarisApplicationID;
end
```

  - Each instance of Imaris application that is running has a unique ID (starting at 0)
  - This code sets the current ID when you run XTension from Imaris.

NOTE: when debugging Imaris in Matlab, you will have to specify the ID to launch code manually

Selecting Surpass Object (Method #1)

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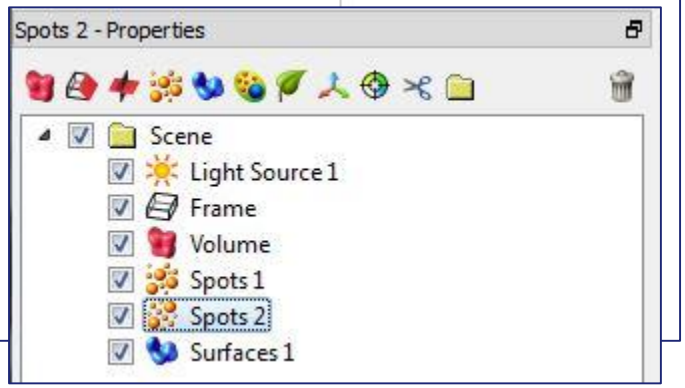
- When a single Surpass scene object is selected in Imaris (Spots, Surface, Filament or Cell)

```
61      % get the spots and the surface object
62 -    vSpots = vImarisApplication.GetFactory.ToSpots(vImarisApplication.GetSurpassSelection);
63 -    vSurfaces = vImarisApplication.GetFactory.ToSurfaces(vImarisApplication.GetSurpassSelection);
64
65 -    vSpotsSelected = ~isequal(vSpots, []);
66 -    vSurfaceSelected = ~isequal(vSurfaces, []);
67 -    if vSpotsSelected
68 -        vParent = vSpots.GetParent;
69 -    elseif vSurfaceSelected
70 -        vParent = vSurfaces.GetParent;
71 -    else
72 -        vParent = vSurpassScene;
73 -    end
```



- This code checks if any Surpass object is selected
  - *i.e. attached screenshot show Spots2, as selected*
- Enters this Object as an active variable in the Matlab environment

Selecting Surpass Object(s) (Method #2)

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```
% the user has to create a scene with some spots
vSurpassScene = vImarisApplication.GetSurpassScene;

vNumberOfSpots = 0;
vSpotsList{vScene.GetNumberOfChildren} = [];
vNamesList{vScene.GetNumberOfChildren} = [];
for vChildIndex = 1:vScene.GetNumberOfChildren
    vDataItem = vScene.GetChild(vChildIndex - 1);
    if vImarisApplication.GetFactory.IsSpots(vDataItem)
        vNumberOfSpots = vNumberOfSpots+1;
        vSpotsList{vNumberOfSpots} = vImarisApplication.GetFactory.ToSpots(vDataItem);
        vNamesList{vNumberOfSpots} = char(vDataItem.GetName);
    end
end

if vNumberOfSpots<2
    msgbox('Please create at least 2 spots objects!');
    return;
end
vNamesList = vNamesList(1:vNumberOfSpots);
vPair = [];
while length(vPair) ~= 2
    [vPair, vOk] = listdlg('ListString',vNamesList,'SelectionMode','multiple',...
        'ListSize',[250 150],'Name','Colocalize spots','InitialValue',[1,2], ...
        'PromptString',{'Please select the 2 spots to colocalize:'});
    if vOk<1, return, end
    if length(vPair) ~= 2
        vHandle = msgbox(['Please select two (2) objects. Use "Control" and left ', ...
            'click to select/unselect an object of the list.']);
        uiwait(vHandle);
    end
end

vSpots1 = vSpotsList{vPair(1)};
vSpots2 = vSpotsList{vPair(2)};
```

Collate and list all Spots Objects

Generate Input dialog to display list and select one or more Objects

Set selected Objects as active variables

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Extracting Image Properties

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- Retrieving some basic image Properties from Volume

```
%Get Image Data parameters
vDataMin = [vImarisApplication.GetDataSet.GetExtendMinX,...
    vImarisApplication.GetDataSet.GetExtendMinY,...
    vImarisApplication.GetDataSet.GetExtendMinZ];
vDataMax = [vImarisApplication.GetDataSet.GetExtendMaxX,...
    vImarisApplication.GetDataSet.GetExtendMaxY,...
    vImarisApplication.GetDataSet.GetExtendMaxZ];
vDataSize = [vImarisApplication.GetDataSet.GetSizeX,...
    vImarisApplication.GetDataSet.GetSizeY,...
    vImarisApplication.GetDataSet.GetSizeZ];
vNumberOfChannels = vImarisApplication.GetDataSet.GetSizeC;
Xvoxelspacing = (vDataMax(1)-vDataMin(1))/vDataSize(1);
Yvoxelspacing = (vDataMax(2)-vDataMin(2))/vDataSize(2);
Zvoxelspacing = (vDataMax(3)-vDataMin(3))/vDataSize(3);

%Get Spots information
vSpotsXYZ = vSpots.GetPositionsXYZ;
vSootsTime = vSpots.GetIndicesT;
vSpotsRadius = vSpots.GetRadiiXYZ;
vSpotsEdges = vSpots.GetTrackEdges;
```

Getting the basic Spot parameters from Imaris

Various Extractable Items

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- Retrieving some basic Surpass object values

Surfaces

GetCenterOfMass (int aSurfaceIndex)
GetIds ()
GetMask (float aMinX, float aMinY, float aMi
GetNumberOfSurfaces ()
GetSelectedIds ()
GetSelectedIndices ()
GetSingleMask (int aSurfaceIndex, float aM
GetSurfaceData (int aSurfaceIndex)
GetSurfaceDataLayout (int aSurfaceIndex)
GetSurfaceNormals (int aSurfaceIndex)
GetTimeIndex (int aSurfaceIndex)
GetTimePoint (int aIndexT)
GetTrackEdges ()
GetTrackIds ()
GetTransform (int aSurfaceIndex)

Spots

Get ()
GetIds ()
GetIndicesT ()
GetPositionsXYZ ()
GetRadii ()
GetRadiiXYZ ()
GetSelectedIds ()
GetSelectedIndices ()
GetTimePoint (int aIndexT)
GetTrackEdges ()
GetTrackIds ()

Filaments

GetBeginningVertexIndex (int aFilamentIndex)
GetColorSpinesRGBA ()
GetEdges (int aFilamentIndex)
GetEdgesSegmentId (int aFilamentIndex)
GetFilamentsList (tInts aFilamentIndices)
GetFilamentTrackEdges ()
GetFilamentTrackIds ()
GetIds ()
GetNumberOfFilaments ()
GetPositionsXYZ (int aFilamentIndex)
GetRadii (int aFilamentIndex)
GetSelectedIds ()
GetSelectedPositionIndex (int aFilamentIndex)
GetSelectedPositionIndices (int aFilamentIndex)
GetTimeIndex (int aFilamentIndex)
GetTypes (int aFilamentIndex)
GetVertexTrackEdges ()
GetVertexTrackIds ()

Preset Scripts: Tracking-related

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- Identify TrackID's and loop each track

```
33      %Identify all track IDs for all spots tracked
34      %Here is a beautiful code that does the mapping without the need of a loop
35      %(the mapping is someway complicated because one spot might be part of
36      %different edges, usually two).
37      edges = Spots.GetTrackEdges + 1;
38      edges_forspots = 1:size(Spots.GetPositionsXYZ, 1);
39      edges_forspots( : ) = size(edges, 1) + 1; % initialize array to fictive edge
40      edges_forspots(edges(:, 1)) = 1:size(edges, 1);
41      edges_forspots(edges(:, 2)) = 1:size(edges, 1);
42      trackid_foredges = [Spots.GetTrackIds; 0]; % add fictive track id
43      trackid_forspots = trackid_foredges(edges_forspots);
44      tempx = double(trackid_forspots);
45      vtrackID = tempx-1000000000;
46      vtrackIDmax = max(vtrackID);
47
48      %Start loop for each track
49      for trackloop = 0:vtrackIDmax;
50      %Identify trackID and create working position matrix array for that trackID
51          vSpotsT = vtrackID == trackloop;
52          tracklength = sum(vSpotsT) ;
53          vSpotsIndex = find(vSpotsT');
54          vWorkingPositionXYZ = vPositionXYZ(vSpotsIndex,:);
55          vWorkingSpotsT = vSpotsT(vSpotsIndex,:);
56          vWorkingSpotsTime = vSpotsTime(vSpotsIndex,:);
57      %
58      %  Do track processing on per track basis
59      %
60
61      end
```

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Preset Script: Filament-related

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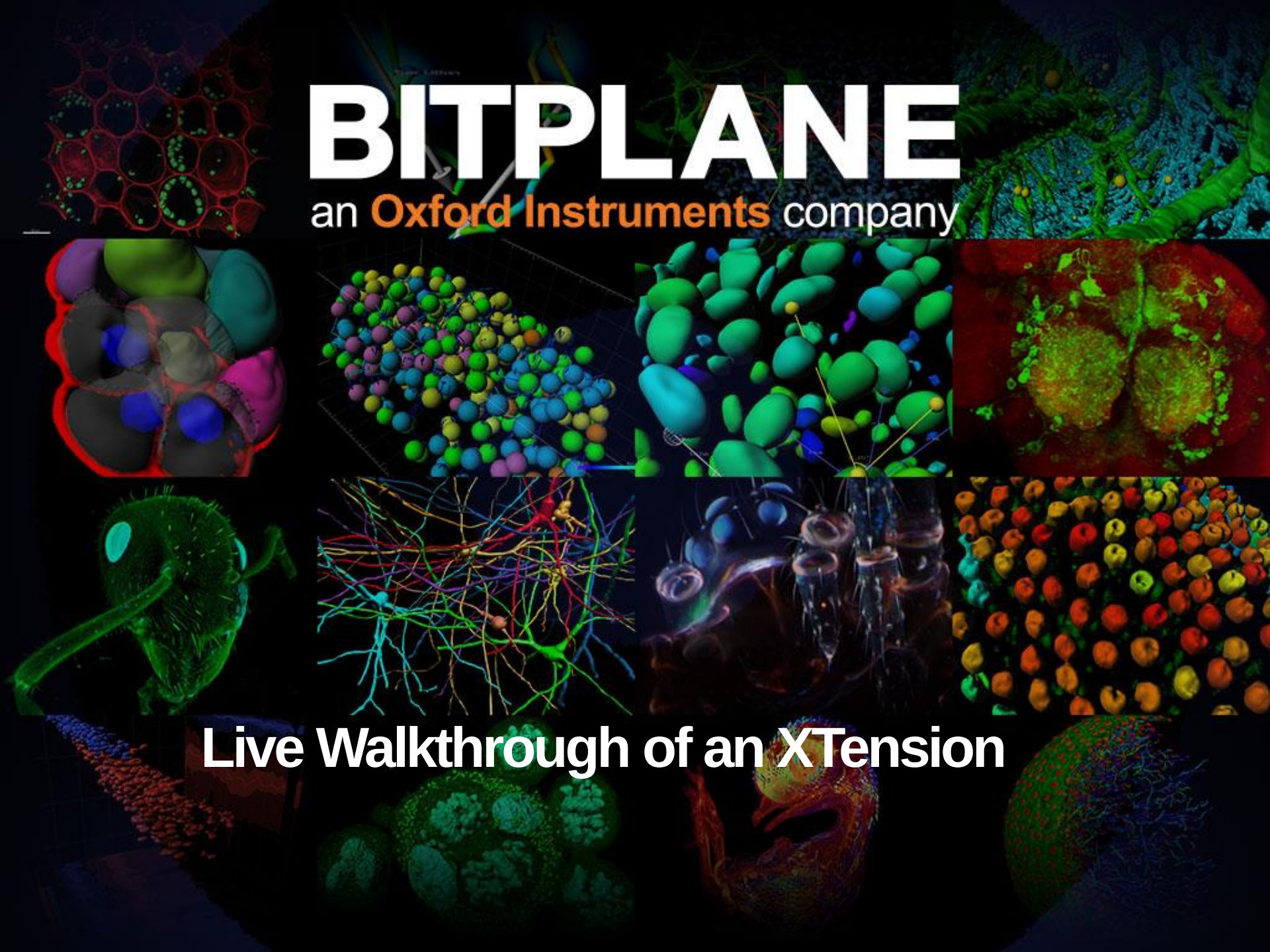
- Loop all points for each dendrite

```
for FilamentIndex=0:NumberOfFilaments
    vFilamentsXYZ = vFilaments.GetPositionsXYZ(FilamentIndex);
    vFilamentsEdges = vFilaments.GetEdges(FilamentIndex) + 1;
    vFilamentsEdgesSegmentId = vFilaments.GetEdgesSegmentId(FilamentIndex);
    vSegmentIds=unique(vFilamentsEdgesSegmentId);%Idenitfy unique filament segmentIDs
    for vBranchIndex=1:vNumberOfDendriteBranches
        %Set the ID for dendrite segment
        wSegmentIndex = vSegmentIds(vBranchIndex);
        vDenddriteDistance(vBranchIndex)=0;
        %Logical arguement to identify spots in segment
        vSpotsT = vFilamentsEdgesSegmentId == wSegmentIndex;
        vSpotsIndex = find(vSpotsT');
        %Identify position for dendrite segment
        %Test with new method of filtering
        vDendriteEdgesWorking=vFilamentsEdges(vSpotsIndex,:);
        vEdgesUnique=unique(vDendriteEdgesWorking);
        vDendritePositionsWorking=vFilamentsXYZ(vEdgesUnique,1:3);
        vDendriteRadiusWorking=vFilamentsRadius(vEdgesUnique,1);
        vTypesWorking=vTypes(vEdgesUnique,:);

    %
    %  Do processing here for one dendrite at a time
    %

    end %loop for each dendrite segment
end%loop fo each Filament

```



Live Walkthrough of an XTension

Configuring Imaris – ImageJ/Fiji Bridge

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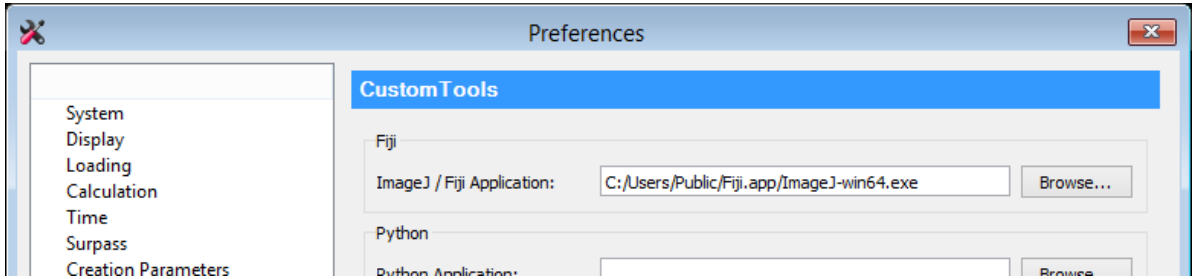
- Copy Fiji/ImageJ to a folder were the all users have write access
  - Optimal location – directly on the **C: drive**
  - **ImageJ/Fiji has no installer, easy to move this program, copy and paste the directory**
  - I am currently using FIJI/ImageJ 1.51p
  - Configure the path to the Fiji/ImageJ executable
    - **Win:** C:/Fiji.app/ImageJ-win64.exe
    - **Mac:** /Applications/Fiji.app/Contents/MacOS/fiji-macosx
- The “bridge” plugin will be installed automatically when you launch the first plugin from Imaris.



ImarisXT: ImageJ/FIJI link

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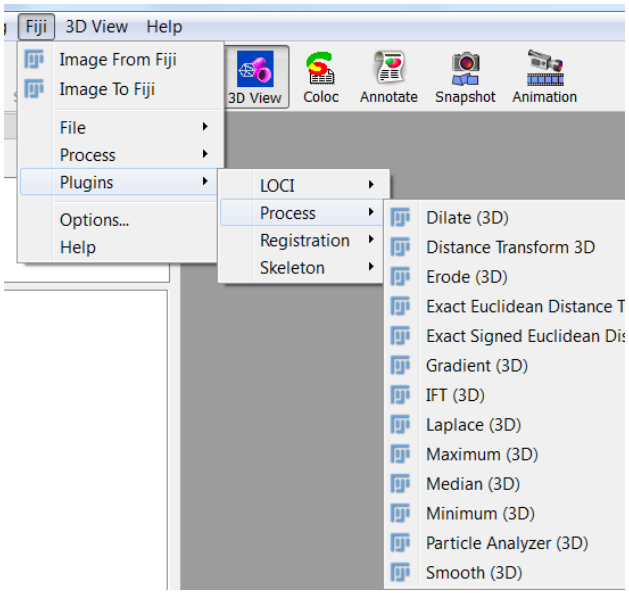
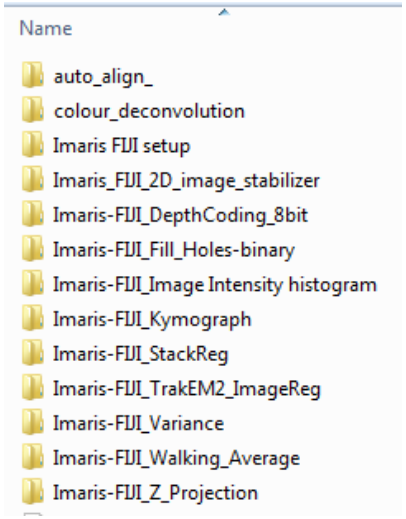
- Embed possible Fiji/ImageJ Plugins
- Menu available, if Fiji/ImageJ configured





file input	image input	other input	
no (e.g. run macro on files only)	yes (e.g. save image to file)	no (e.g. store PCA result as file)	**file output**
yes (e.g. load image from file)	yes (e.g. gaussian image filter)	no (*)	**image output**
no	(yes) output not fed back to Imaris	no (e.g. do PCA based on some statistics)	**other output**

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Imaris XT: ImageJ/Fiji plugin Embedding

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- Simple text file (see example below)

Sets location in Imaris menu

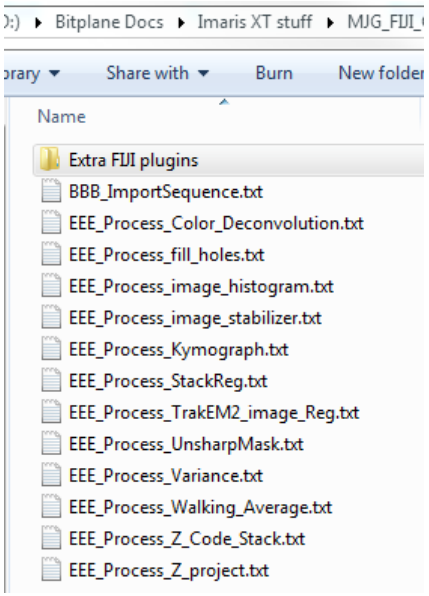
Sends volume from Imaris to Fiji

Launches plugin by specific name in Fiji

```
// <CustomTools>
//   <Menu name="Fiji">
//     <Submenu name="Process">
//       <Item name="UnSharpMask" icon="Fiji">
//         <Command>ImageJ::EEE_Process_UnsharpMask</Command>
//       </Item>
//     </Submenu>
//   </Menu>
// </CustomTools>

call("Imaris_Bridge.In", getArgument());
run("Unsharp Mask...");
call("Imaris_Bridge.Out", getArgument());
```

Sends processed volume back into Imaris Scene (over writing existing Volume object)

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Imaris Open

Forum

File Exchange

Imaris XT Developer Program

What Can the IO Platform Be Used for?

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Organic FAQ

Meeting point between Life and Computer Scientists

A place for collaborative work

Word-of-Mouth / Reference Point

Centralized platform for requesting and sharing XTensions

Curated repository of XTensions (citable, unique and permanent url)

Imaris XT Developer Program (Early Adopters)

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Aaron Ponti

Angela Stathopoulos

Christopher Wood

Jean-Yves Tinevez

Jonas Dorn

Josh Thackray

Mario Emmenlauer

Mary Cathleen McKinney

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