Parent-Child Analysis Application

Description:

The application is designed to provide workflow for parent-child analysis applications. The app allows creating parent-child projects that streamline the analysis and provide the complete set of relational data.

User Interface:

The application ParentChild.ipp (ipx) can be added to the Project Workbench. When it's loaded it has the following icon in the Apps group:
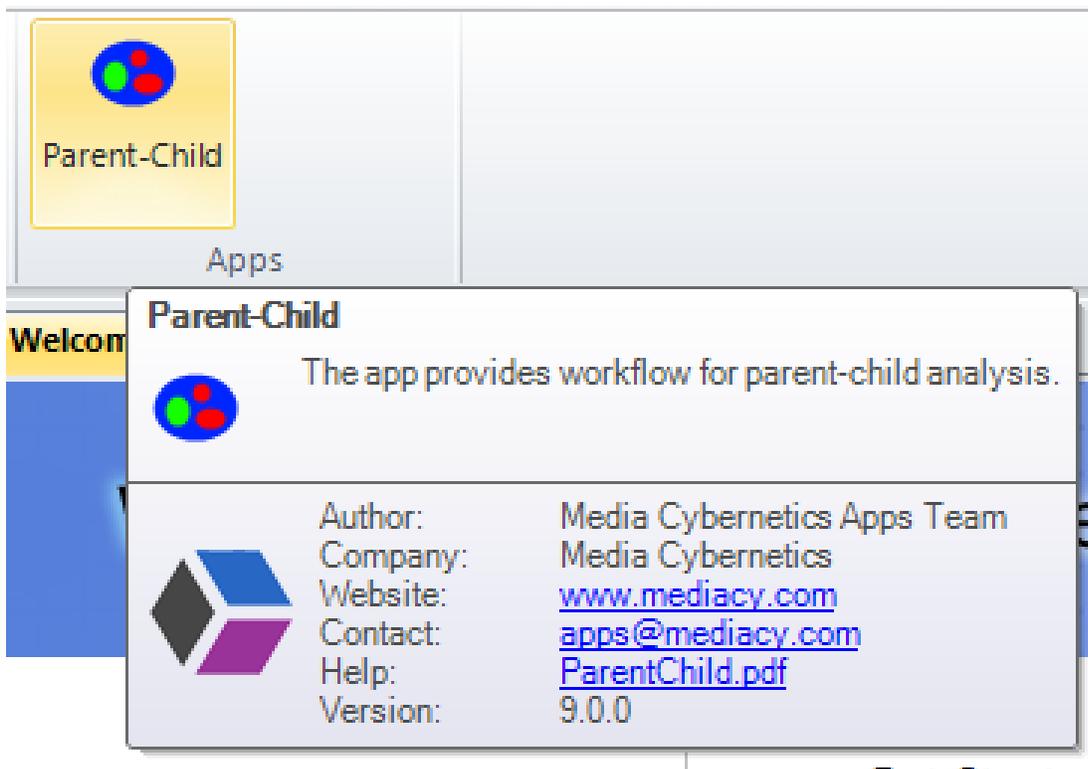
Activating the app adds the Parent-Child panel app:
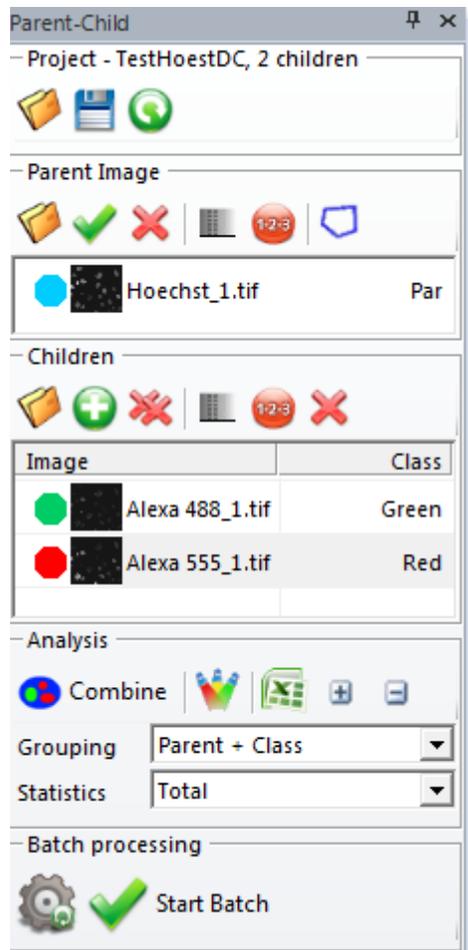
The application allows creating and reusing Parent-Child projects to process multiple images using the same segmentation and relational options.

There are 4 groups of controls exposed in the UI:

1. *Project* - the group that contains controls to **Load** , **Save** and **Reset** projects.

2. *Parent Image* - includes controls to **Load** , **Set** , **Remove** , **Segment** and **Count** the parent image. Use **Draw** to draw parent objects outlines manually. Parent image contains object that define outlines for child objects.

3. *Children* - includes controls to **Load** , **Add** , **Remove** , **Clear** , **Segment** and **Count** child images. Child image can be the same as parent or a different image with the same size as parent image. Child images contain objects that related to objects on parent image.

4. *Analysis* - the group that includes controls for combining the images and analyzing the data.

5. *Batch Processing* – the group contains controls for batch processing of multiple images/folders.

Creating Parent-Child project

The reusable parent-child analysis project can be created using the following steps.

1. Reset project clicking the **Reset** button in the Project group.

2. Load image from disk or activate image that will be the Parent and click the **Set** button of the Parent group. The image will be set as Parent image.

3. You can use the options on Count/Size tab to define proper segmentation option (Threshold segmentation or Smart), then click the **Segment** button and define the threshold or segmentation recipe (in case of smart segmentation). You can set segmentation colors and class names in the segmentation dialogs.

4. Click the **Count** button to count parent object. At that moment the Count/Size options and segmentation parameters will be set to the project template and the outlines of the parent object created.

   4a) Parent object outlines can also be drawn manually using the **Draw** button.

The class name with corresponded color will be shown in the Parent list:
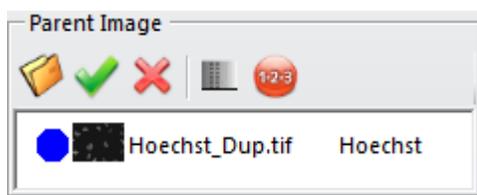
5. Load image from disk or activate child image and click the **Add** button of the *Children* group. The image will be added as a child.

6. Select that image in the list and click the **Segment** button to define segmentation parameters for the child channel. Note, that the segmentation type and parameters for parent and every child can be absolutely different. You can also set colors and class names for child channels.

7. Click the **Count** ![count button] button to count child object. At that moment the Count/Size options and segmentation parameters will be set to the project template and the outlines of the child object created.

8. Repeat steps 5 - 7 for all child images. Note and you may use the same images as multiple children using different segmentation parameters (threshold/recipe).

All child images with their class names and colors will be listed in the Children list:
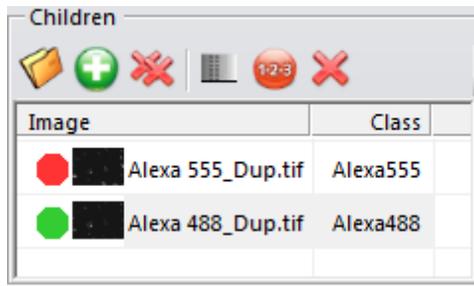
9. If this project is going to be used with Batch Processing, then you can also specify Data Collector measurements, which will be collected from the result image. The list of measurements will also be a part of the saved project.

10. Now you can save the project to be reused using the **Save** ![save button] button in the *Project* group and/or start the *Analysis*.

Analyzing Parent-Child relations

When Parent and Children objects are counted the button **Combine** ![combine button] is enabled and you can click it to created a combined image with data from parent and child images.
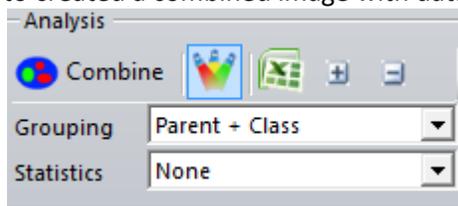
When the **Merge** ![merge button] button is checked, the parent and child images get merged to a color image and the result outlines are added to that image. When the button is unchecked, the result is placed to the

Parent image. **Expand** and **Collapse** ![expand collapse buttons] buttons controls nodes in the data table. The results can

be exported to Excel clicking the **Excel** ![excel button] button.

Optionally the **Grouping** of the data in the data table can be activated. It can be one of the following: *None, Parent, Parent + Class.*
The **Statistics** in the data table can be set to *None, Total* or *Group* (to show grouping statistics).

The result image and data table will look as the example below (the Parent, Class Name and Percent Area Parent measurements are added automatically):
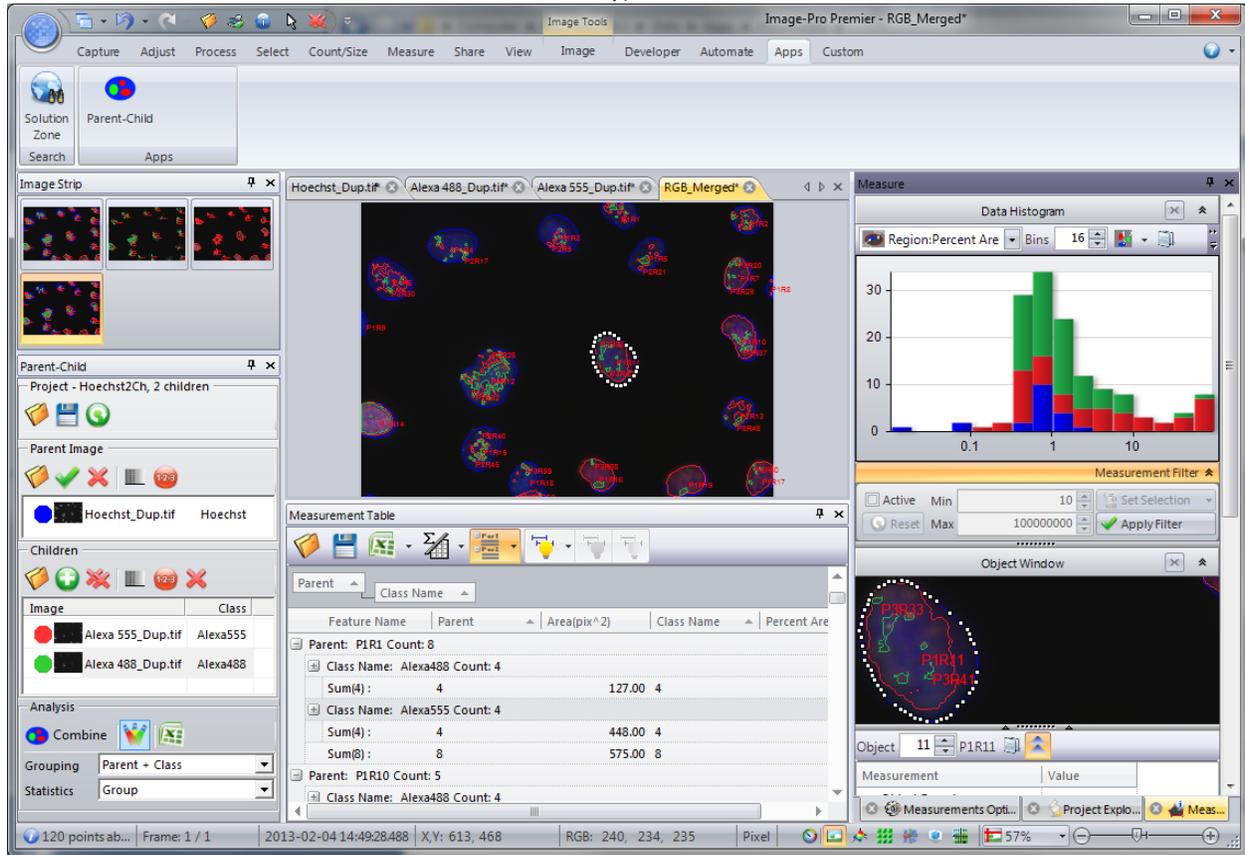
Reusing Parent-Child project

The parent-child projects can be reused with other image of the same type to execute parent-child analysis on multiple images. Use the following steps:

1. Load parent-child project using the to *Load* button of the Project group. The project group title will show the name of loaded project and indicate the number and class names of expected children and the parent in the project:
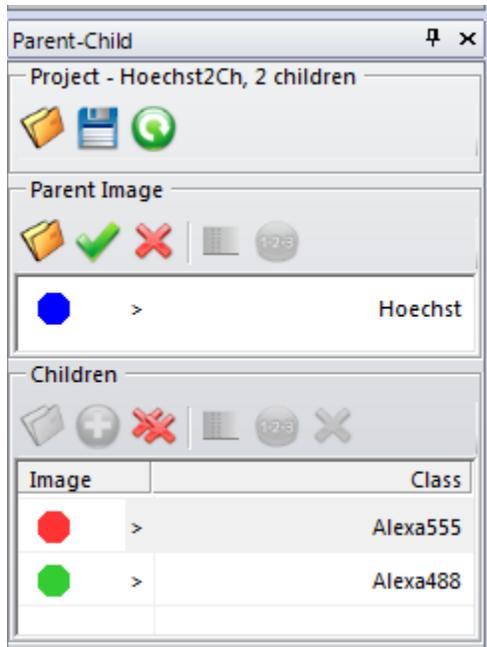
2. . Load 📁 image from disk or activate image that will be the Parent and click the **Set** ✔ button of the Parent group. The image will be set as Parent image, at the same moment the segmentation options from the project will be applied to the parent image. In case of Smart segmentation, the segmentation mask will be shown.

3. **Optionally** you can click the **Segment** ▥ button to check the correctness of the segmentation and adjust thresholds/recipe if necessary.

4. Click the **Count** 🔴 button to count parent object.

5. . Load 📁 image from disk or activate child image and click the **Add** ➕ button of the *Children* group. The image will be added as a child. At the same moment the segmentation options from the project will be applied to the child image. In case of Smart segmentation, the segmentation mask will be shown.

6. **Optionally** you can click the **Segment** ▥ button to check the correctness of the segmentation and adjust thresholds/recipe if necessary.

7. Click the **Count** 🔴 button to count child object.

8. Repeat steps 5 - 7 for all child images.

After that the project is ready for Analyzing Parent-Child relations.

Batch Processing

Multiple Experiments can be analyzed automatically using Batch Processing functionality.
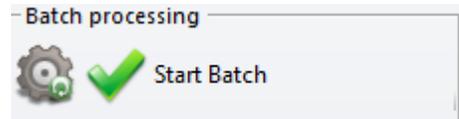
Clicking the Open Batch panel button will open the panel, where you can specify batch folders and define the grouping order, so images in groups are arranged from Parent to Children as on the example below:

Batch Processing 📌 ×

1. Select Macros

Run Before	🔧 RunBeforeMacro ❌ ▾
Loop On	🔧 LoopOnMacro ❌ ▾
Run After	🔧 RunAfterMacro ❌ ▾

2. Select Images

🖼➕ ▾ 📁➕ ▾ ❌ ❌❌ 📋 ▾

Sort by [full path]   As Numbers ▾

▲ ·········· ▲

F...	Items to Process	▾	G ▲
⊟ **Group by: D:\Images\ParentChild\Batch2\G...**			
	D. Hoechst_1.tif	D:...	
	D. Alexa 555_1.tif	D:...	
	D. Alexa 488_1.tif	D:...	
⊟ **Group by: D:\Images\ParentChild\Batch2\G...**			
	D. Hoechst_2.tif	D:...	
	D. Alexa 555_2.tif	D:...	
	D. Alexa 488_2.tif	D:...	

3. Start Batch Process

⚙️
Start

☑ Show Task Manager
☑ Display Documents
☐ Save Modified
☑ Close Documents
☐ Monitor Folders

✅ Start Batch

Then you can click the **Start Batch** button to process all experiments. The data from experiments will be collected to the Data Collector and displayed in the end of processing. (Note, that Measurement list is a part of the Project file).

You can save the data to a file or send to Excel.

Demo files:

Demo image can be loaded from **\Demo Images\Objects within Objects\DNA** folder.

Code:

The code can be used as an example to low-level image processing and measurements. The application runs in Compiled mode for better performance.

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