

User's Manual

This manual provides general information and operating instructions for software for processing astronomical images of galaxies with complex spiral structure - "***Straightened spiral arm detector***" (***SSAD***).

The software is designed to simplify the processing of spiral galaxy patterns to extract straight arm segments (*rows*), partially or fully automating the operations associated with the process.

The software is primarily intended for use by the scientific community in conducting research on the detection of vertex spiral galaxies.

Manual version v1.2.0
Programme version v2.4.0

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Programme functions

- Loading images in formats: PNG, JPG, JPEG.
- Saving images in PNG, JPG, JPEG formats.
- Bringing an image to a floating view (rotate and stretch).
- Selection of rows by *Adaptive method of skeletonisation Zong-Sun*. Multiple image processing by *Adaptive Zong-Sun skeletonisation method*.
- Interface language: Russian, English.

System Requirements

Minimum configuration requirements [PC](#).

- Operating system: Windows 10.
- Free space on the hard disc: 250 MB.
- RAM capacity: 1 GB.
- Processor frequency: 2.3 GHz.
- Number of processor cores: 2.

Installation of the programme

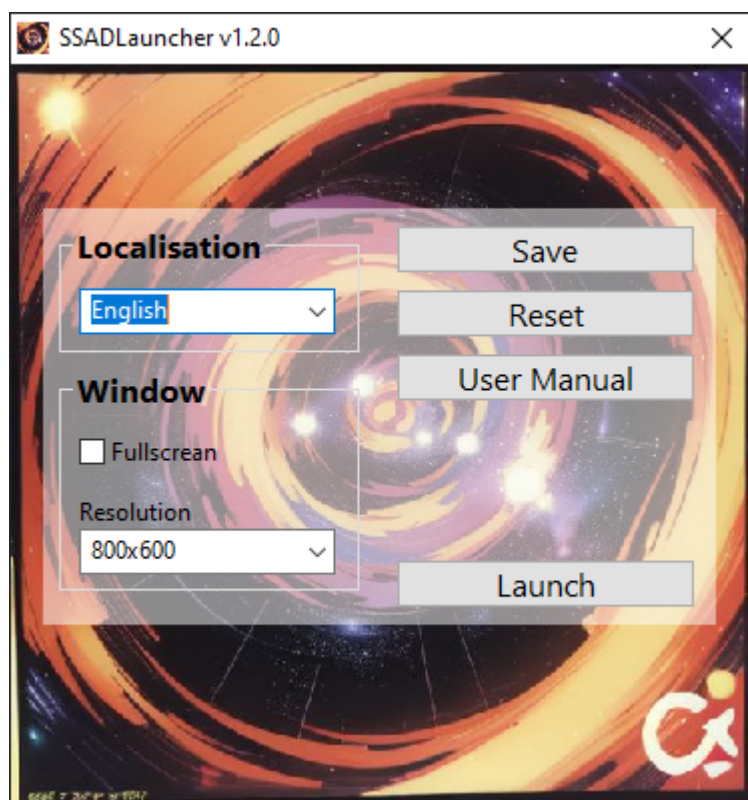
The software and all components necessary for work are distributed as an archive. Before you start working, you should unzip the files to a convenient place on your hard disc.

WARNING! It is strongly not recommended to delete, modify or move the programme files. These actions may adversely affect its performance.

Start the programme

To launch the program you need to run the file **SSADLauncher.exe**, located in the folder specified during unpacking on your hard drive.

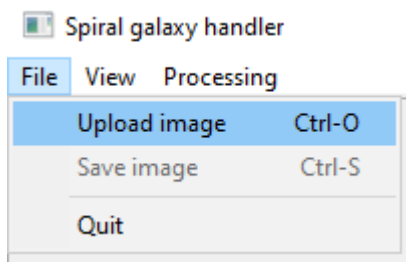
The following actions are available in the [Launcher](#) window.



- **Language** - change the [interface](#) language of the Launcher and the programme.
- **Fullscreen** - launch the programme window in full screen.
- **Resolution** - set the size of the programme window when not running full screen.
- **Save** - saves the set parameters.
- **Reset** - resets the set parameters to default values (you must save to apply).
- **Manual** - opens this manual in a browser window.
- **Start** - starts the main programme.

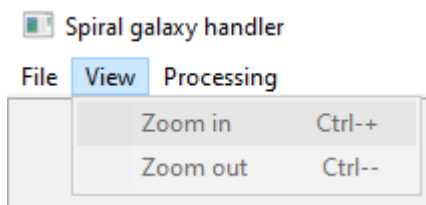
Main window of the programme

"File" menu



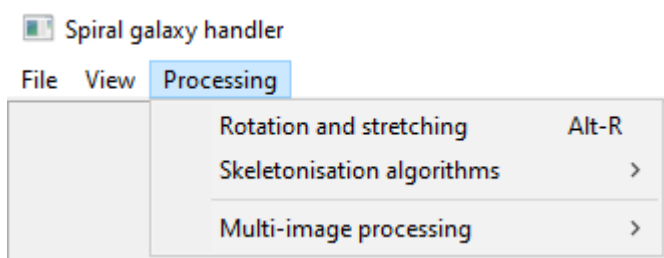
- **Load Image** - load image for processing in PNG, JPG, JPEG formats.
- **Save Image** - saves the processed image in PNG, JPG, JPEG formats. Available after image loading.
- **Quit** - close the programme.

Menu "View"



- **Zoom** - zooms in on the image in the [preview](#) window. Available after the image is loaded.
- **Down** - zooms out the image in the preview window. Available after the image is loaded.

Menu "Processing"



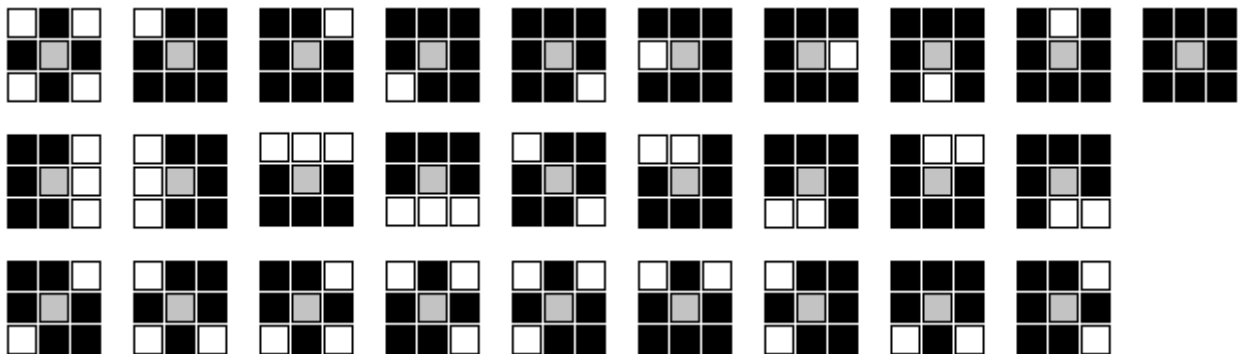
- **Rotate and Stretch** - brings the image to [flat view](#). Available after the image has been loaded.
- **Skeletonisation Algorithms** - ready-made sets of algorithms for processing an image by [skeletonisation](#).
- **Multiple Image Processing** - ready sets of algorithms for multiple image processing by different methods..

Skeletonisation algorithms

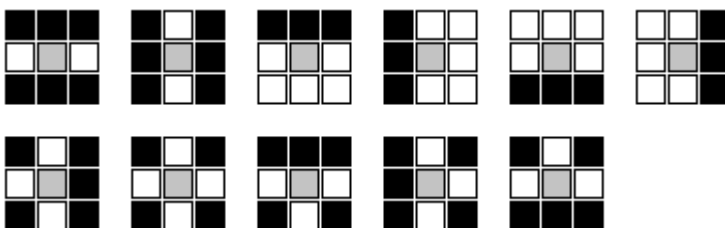
Adaptive Zong-Sun`s

Adaptive skeletonisation using the Zong-Sun method consists of the following processing algorithms.

1. adaptive Gaussian binarisation.
2. Reducing the image size while preserving the aspect ratio. Affects the performance and detail of the image.
3. Threshold binarisation. The lower the value, the more detail remains, and the higher the value, the less noisy the image becomes.
4. Adding missing pixels using a template. Used to improve the skeleton structure.



5. Removing extra pixels according to the template. Used to remove noise.



6. Skeletonisation using the Zong-Sun method.

The settings window of the Zong-Sun method consists of the following items.

Zhang-Suen method settings

Threshold binarisation value:

125

Gaussian constant:

0

Image compression percentage:

20

Gaussian block size value (odd):

3

Process

- **Binarisation threshold value** - used in the third step of the algorithm to bring the image to binary form, as well as to change the level of its detail, in particular, to reduce noise and, as a consequence, to

highlight the structure of the sleeves more clearly.

- **Gaussian constant** - subtracted from the weighted average value. Affects the level of skeleton detail.
- **Image Compression Percentage** - the percentage to which the image is compressed relative to the original image. It affects the processing and detailing time of the final image.
- **Gauss block size value (odd)** - used to specify the number of neighbouring pixels for threshold calculation.
- **Process** - starts image processing with specified parameters.

Multiple processing algorithms

Adaptive Zhang-Suen

The multiple image processing window of the Zonga-Sun meotod consists of the following elements.

Множественная обработка: Адаптивный метод Зонга-Суня

Папка загрузки изображений... Папка сохранения изображений...

Параметр	Минимум	Максимум	Шаг
Пороговая бинаризация:	<input type="text" value="125"/>	<input type="text" value="125"/>	<input type="text" value="1"/>
Гауссова постоянная:	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="1"/>
Процент сжатия изображения:	<input type="text" value="20"/>	<input type="text" value="20"/>	<input type="text" value="1"/>
Размер блока Гаусса:	<input type="text" value="3"/>	<input type="text" value="3"/>	<input type="text" value="2"/>

Обработать

- **Take the source images from** - path to the folder from which images will be uploaded for processing.
- **Save the processed images to** - path to the folder where images will be saved for processing.
- **Parameter** - column containing names of processing parameters.
- **Min** - column containing minimum values of parameters.
- **Max** - column in which the maximum values of parameters are specified.
- **Step** - column, in which the step of increment of processing parameter value is indicated.
- **Binary threshold** - see. [Adaptive Zhang-Suen](#).
- **Gaussian constant** - see. [Adaptive Zhang-Suen](#).
- **Image compress percentage** - see. [Adaptive Zhang-Suen](#).
- **Gauss block size** - see. [Adaptive Zhang-Suen](#).
- **Process** - starts the multiple processing process with the specified parameters.

After the processing starts, the following items will be displayed and the remaining items will become inaccessible.

Множественная обработка: Адаптивный метод Зонга-Суня

Папка загрузки изображений... Папка сохранения изображений...

Параметр	Минимум	Максимум	Шаг
Пороговая бинаризация:	<input type="text" value="125"/>	<input type="text" value="125"/>	<input type="text" value="1"/>
Гауссова постоянная:	<input type="text" value="-2"/>	<input type="text" value="125"/>	<input type="text" value="1"/>
Процент сжатия изображения:	<input type="text" value="20"/>	<input type="text" value="20"/>	<input type="text" value="1"/>
Размер блока Гаусса:	<input type="text" value="3"/>	<input type="text" value="9"/>	<input type="text" value="2"/>

Готово/Всего : 19/48

Прервать

Обработать

- **Progress bar** - visual display of the number of processed images.
- **Counter** - numerical display of the number of processed images.
- **Stop** - button to stop processing.

Bringing it to the "flat" view

The ToPlainView window consists of the following items.

Rotation and stretching

Rotation

Current value: 0 Set value: 0 deg

Stretch

Current width: 128 Set width: 128 px

Current height: 128 Set height: 128 px

☐ Live Preview Apply

- **Current rotation value** - displays the current rotation angle of the image.
- **Set rotation value** - enter a new value of the image rotation angle.
- **Current Width** - displays the current image width.
- **Set Width** - enter a new image width.
- **Current Height** - displays the current height of the image.
- **Set Height** - enter the new height of the image.
- **Live Preview** - processing mode when all changes are immediately displayed on the screen without the need to press the *Apply* button.
- **Apply** - applies the entered values to the loaded image.

Glossary

Rows

One of the structural features of spiral galaxy patterns. Polygonal arms formed by straight segments.

PC

Personal computer.

Launcher

A programme that runs any programmes or processes.

Interface

A system of means for user interaction with electronic devices, based on the representation of all system objects and functions available to the user in the form of graphic screen components (windows, icons, menus, buttons, lists, etc.).

Flat view

The image is rotated and stretched along one of the axes. Applies to galaxies located at an angle to the observer.

Skeletonisation

It makes it possible to represent a binary image as a set of thin lines whose mutual location, size and shape adequately describe the size, shape and orientation in space of the corresponding image regions.

Supplementary materials

1. Vorontsov-Velyaminov B. A. On the nature of a new feature in the galaxy M 81 // Soviet Astronomy. - 1967. - Vol. 10, no. 6. - P. 1057-1058.
2. Galaxies with Rows / A. D. Chernin [et al.] // Astronomy Reports. - 2001. - Vol. 45, no. 11. - P. 841-853.
3. Butenko M. A., Khoperskov A. V. V. Galaxies with "twirls": a new catalogue // Astrophysical Bulletin. - 2017. - Vol. 72, no. 3. - C. 256-275.
4. Butenko M. A. Statistical processing of images of spiral galaxies with polygonal structures // Bulletin of Volgograd State University. - 2015. Vol. - 26, no. 1. - C. 52-60.