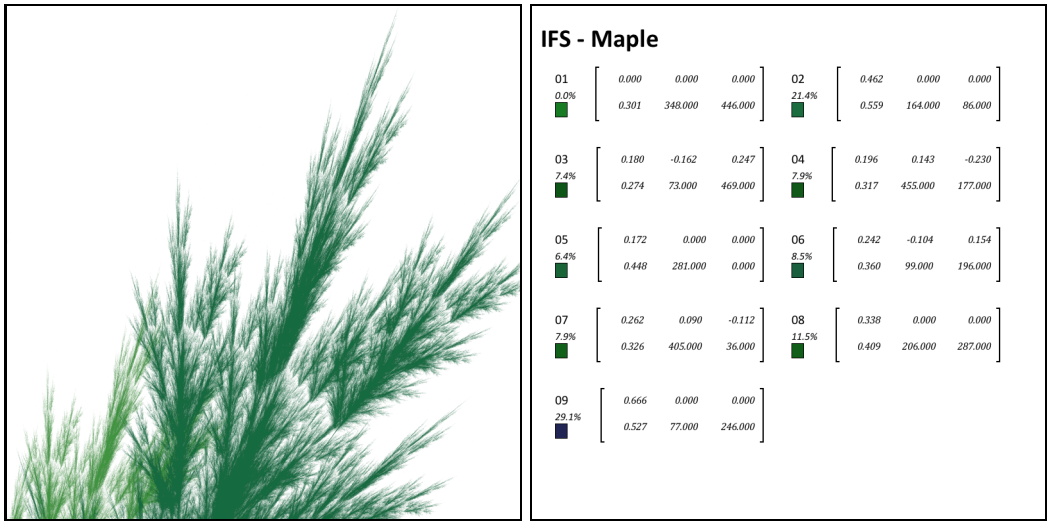
IFS Explorer 1.0.6

Iterated Function System Explorer

An interactive **Iterated Function System** explorer. This program allows you to explore a vast world of complex and beautiful fractal images produced by simple mathematical rules, through a process of trial and error, experimentation and exploration. See the *References* section below for more details on the mathematics and concepts behind these systems.

IFS Explorer provides an interactive UI to create and manipulate a set of affine transforms, which are then iterated randomly to produce an image. The Java `AffineTransform` class is used to represent and plot the transforms. The systems can be saved and loaded as XML files, and rendered images can be exported as PNG graphics files.



*Screenshots for the **Viewer** and **Details** modes.*

Program requirements

- Java 1.7.0 Runtime Environment
- Windows, Linux or OSX Operating System
- Maven and 1.7.0 JDK for building *(Optional)*

Instructions

Either build the program using Maven or extract one of the packaged distributions. These can be downloaded from GitHub as either `.tar.gz` or `.zip` archives. Then run the relevant script for your operating system.

```
$ ./bin/explorer.sh [-f] [-c] [-p] [ifs.xml]
$ ./bin/explorer.command [-f] [-c] [-p] [ifs.xml]
C> .\bin\explorer.cmd [-f] [-c] [-p] [ifs.xml]
```

Alternatively, the `iterator-1.0.6-jar-with-dependencies.jar` .jar file can simply be downloaded and executed directly, with the `java -jar` command.

```
$ java -jar iterator-1.0.6-jar-with-dependencies.jar
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    Iterated Function System Explorer Version 1.0.6
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    Licensed under the Apache Software License, Version 2.0
    https://grkvlt.github.io/iterator/
```

The program can be controlled by setting properties (see the *Configuration* section) or by specifying flags as command-line arguments. To place the application into full-screen mode add the `-f` or `--fullscreen` flag to the command-line.

Enable colour rendering with the `-c` or `--colour` flag. This will use a fixed list of colours for the transforms. To use a colour palette taken from a sample image, specify `-p` or `--palette`. The image used can be set with the `explorer.palette.file` system property and can be one of *abstract*, *wave* or *car*.

Configuration

- `explorer.grid.min` - Minimum grid spacing - *10*
- `explorer.grid.max` - Maximum grid spacing - *50*
- `explorer.grid.snap` - Snap-to-grid spacing- *5*
- `explorer.palette.file` - Colour palette image source - *abstract*
- `explorer.palette.size` - Number of colours in palette - *64*

- `explorer.palette.seed` - Random seed used for choosing colours - *0*
- `explorer.window.width` - Width of main window - *600*
- `explorer.window.height` - Height of main window - *600*
- `explorer.debug` - Enable debugging mode - *false*
- `explorer.mode` - Setup colour mode - *palette*

The configuration options listed can be set in a property file, which can then be loaded by the application. The locations searched for configuration files are the users `HOME` directory, for a file named `.explorer.properties`, the current directory for a file named `explorer.properties` and finally the file specified on the command line using the `--config config.properties` option.

```
$ ./bin/explorer.sh --config debug.properties ./data/koch.xml
```

It is also possible to set individual configuration options as system properties, using the `JAVA_OPTS` environment variable.

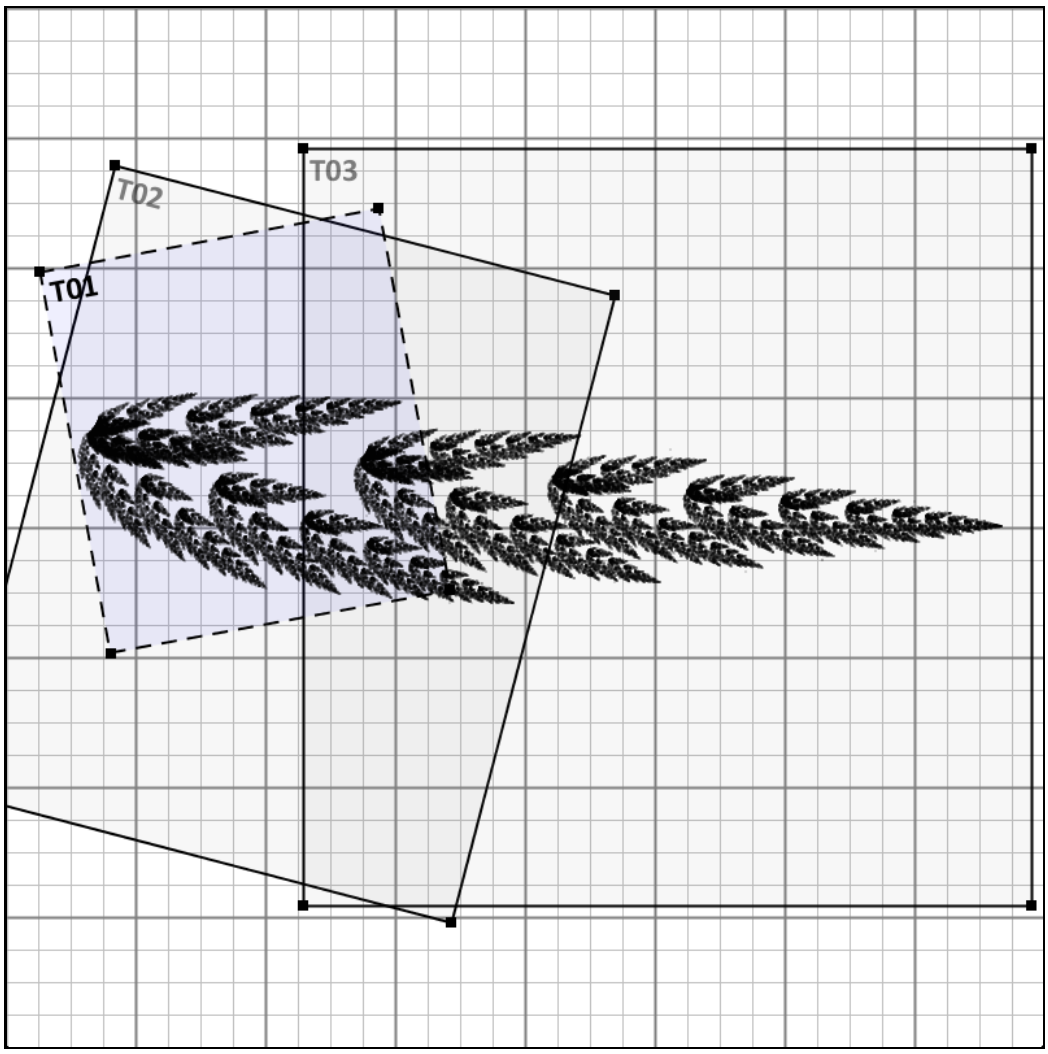
```
$ export JAVA_OPTS="-Dexplorer.palette.file=wave \
> -Dexplorer.palette.seed=1234"
$ ./bin/explorer.sh --colour --palette ./data/spikes.xml
```

Usage

A series of example XML data files for IFS transforms are provided in the `data` directory of the distribution. Some of these can be found in the **The Computational Beauty of Nature** and **Superfractals** books, details of which are given in the *References* section. To load the examples, specify the path to the file as the last argument on the command-line. Sample images for these transforms have also been provided, so be sure to use the `.xml` file, not the `.png`.

Once the program starts, it will diplay an empty grid in the **Editor** mode. The menus provide access to standard operations, including the ability to switch modes. The keyboard can also be used to toggle between modes using the *Tab* key.

A live view of the generated IFS is displayed at low resolution to give an idea of the eventual rendered image of the fractal. **This capability is unique among IFS generating applications.** It allows much more creativity when designing an IFS. By showing the results of changes to a transform immediately it is possible to reach the desired final image much more quickly.



*Screenshot of the **Editor** mode with the live IFS view*

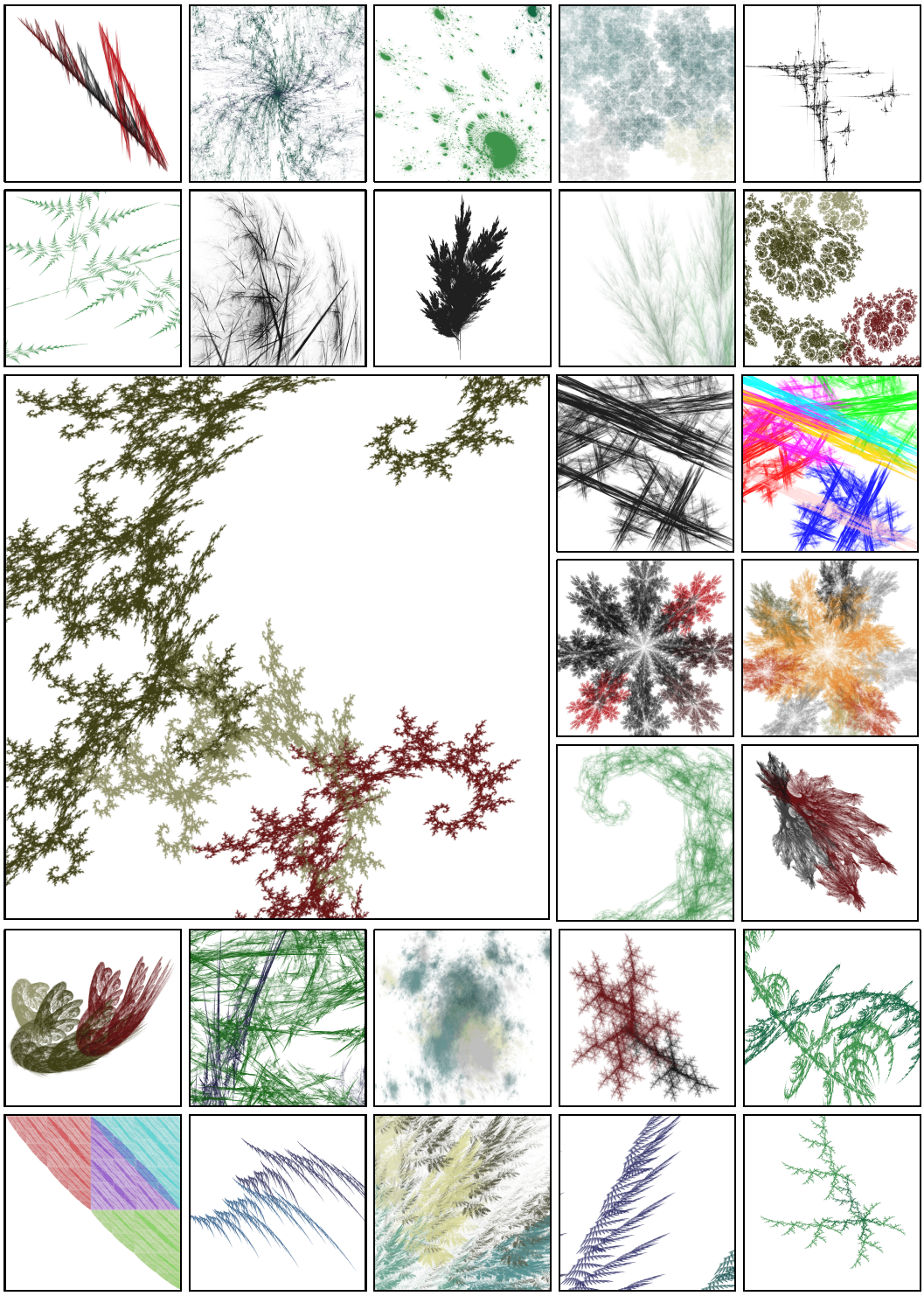
In the **Editor** mode, clicking and dragging the mouse will create a new transform which can then be moved, resised and rotated (with ***Shift*** held down) as desired. In this mode, the ***Delete*** or ***Backspace*** key will delete the selected transform and the ***Left*** or ***Right*** arrow keys will rotate it by ninety degrees.

When in **Viewer** mode the ***Space*** key will pause and continue the rendering process. To zoom into the fractal select a specific area using the left mouse button, or use the ***z*** and ***Z*** keys to to zoom in and out of the centre of the image by a factor of two.

Note *that when zoomed in at high magnification the iterative process can take a very long time until the rendered fractal becomes visible.*

The **Details** mode shows the actual affine transforms and their matrix coefficients for the system as a scrollable list.

Examples



Gallery of fractal images produced using IFS Explorer.

TODO

- Properties editor for transform
  - Matrix coefficients *or* rotation/displacement/scale values
- Preferences dialog

- Better Operating-System integration
  - Printing
  - Native full-screen mode
  - Support native windowing system features
- Better editing UI
  - Add flip, skew, perspective etc. transforms
  - Rotate using handles only
  - Preserve aspect ratio on resize option
- Embedded Applet
- JNLP Web Start client
- JavaFX UI

References

1. **Iterated Function System**; *http://en.wikipedia.org/wiki/Iterated_function_system*; *Wikipedia*
2. **Affine Transform**; *http://en.wikipedia.org/wiki/Affine_transformation*; *Wikipedia*
3. **Construction of fractal objects with iterated function systems**; *http://www-users.cs.umn.edu/%7Ebstanton/pdf/p271-demko.pdf*; *Demko, Stephen and Hodges, Laurie and Naylor, Bruce; SIGGRAPH Computer Graphics, Volume 19, Number 3, 1985*
4. **Superfractals: patterns of Nature**; *http://www.amazon.co.uk/SuperFractals-Michael-Fielding-Barnsley/dp/0521844932*; *Barnsley, Michael F; Cambridge University Press; 7 Sep 2006; ISBN 978-0521844932*
5. **The Computational Beauty of Nature: Computer Explorations of Fractals, Chaos, Complex Systems and Adaptation**; *http://www.amazon.co.uk/The-Computational-Beauty-Nature-Explorations/dp/0262561271*; *Flake, Gary W; MIT Press; 1 Mar 2000; ISBN 978-0262561273*
