Multi-Tiling Plotter in Matlab 7.0.1 (R14)

This readme gives an introduction how to use the matlab file "tiling1.m" to create plots of self-affine tilings with several tiles ("multi-tilings") as described in [GrHaRa].

1. Introduction

(Self-affine) tilings with several tiles (so called "multi-tilings") are useful for wavelet theory due to their connection to multiwavelet bases of L^2.
The mathematical background is described in [GrHaRa] in details.

2. Before you start

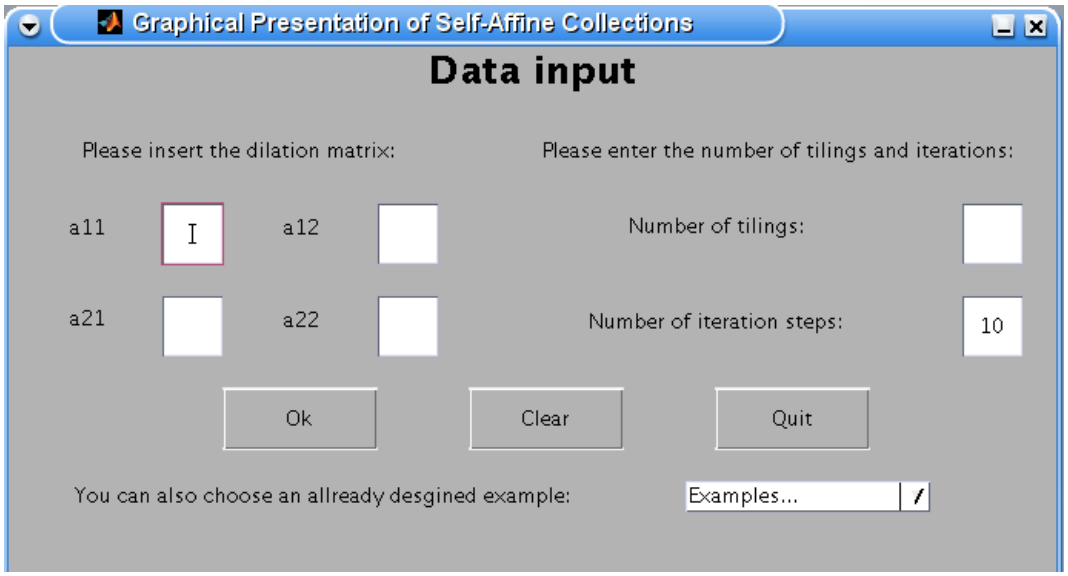
Two files are needed to run the multi-tiling plotter. "tiling1.m" calculates the tiling sets, "tiling1.fig" is used to create a graphical user interface (GUI) for your comfort.

Please copy both files to the same directory on your system!

3. Running the program

To run the program do the following steps:

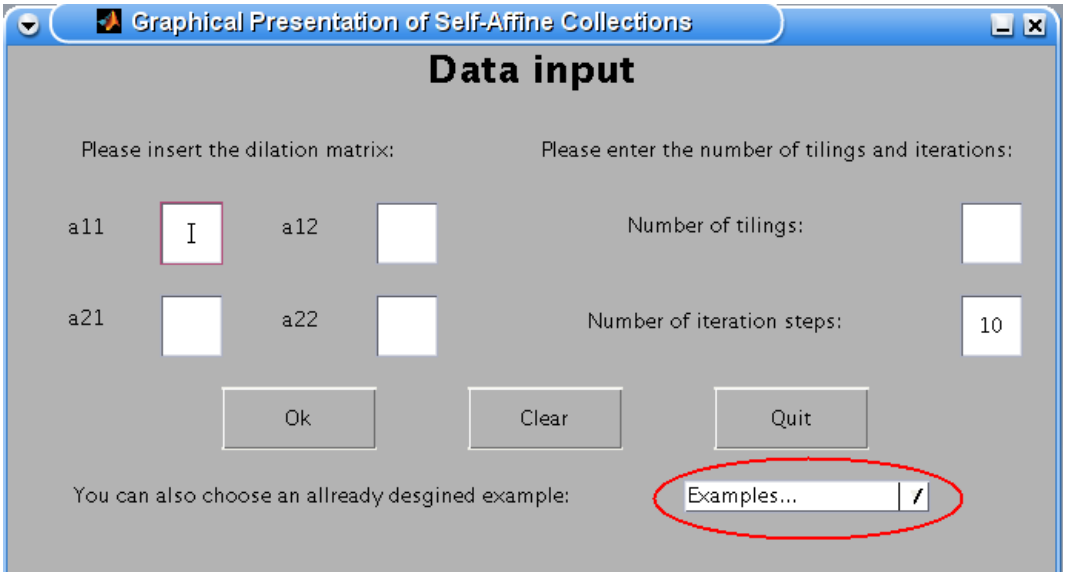
a. Open Matlab.
b. Change to the directory containing "tiling1.m" and "tiling1.fig".
c. Start the programm with "tiling1".
   The GUI "Graphical Representation of Self-Affine Collections" (see below) opens.



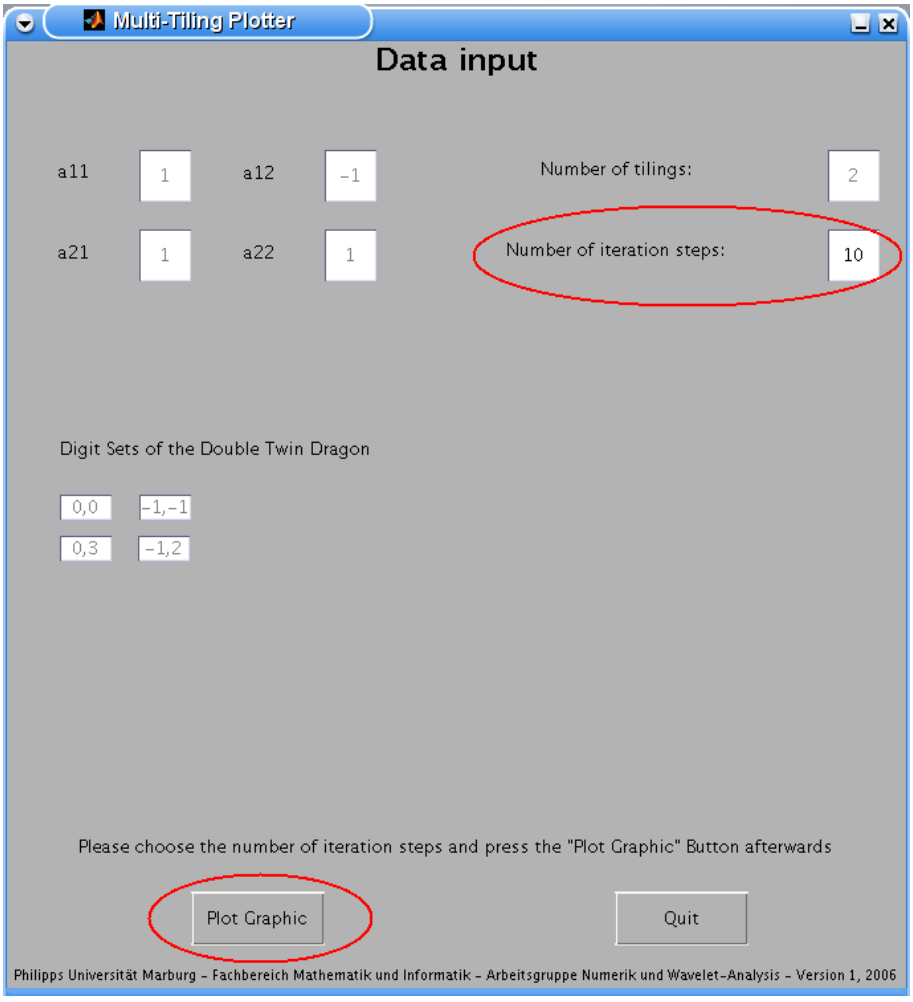
You can use the program in two different ways:
- Using already designed examples
- Enter your own values

4. Running the examples

Some well known examples (like “the twin dragon”) have been implemented already. To choose one of the examples you use the popup-menu “examples”.

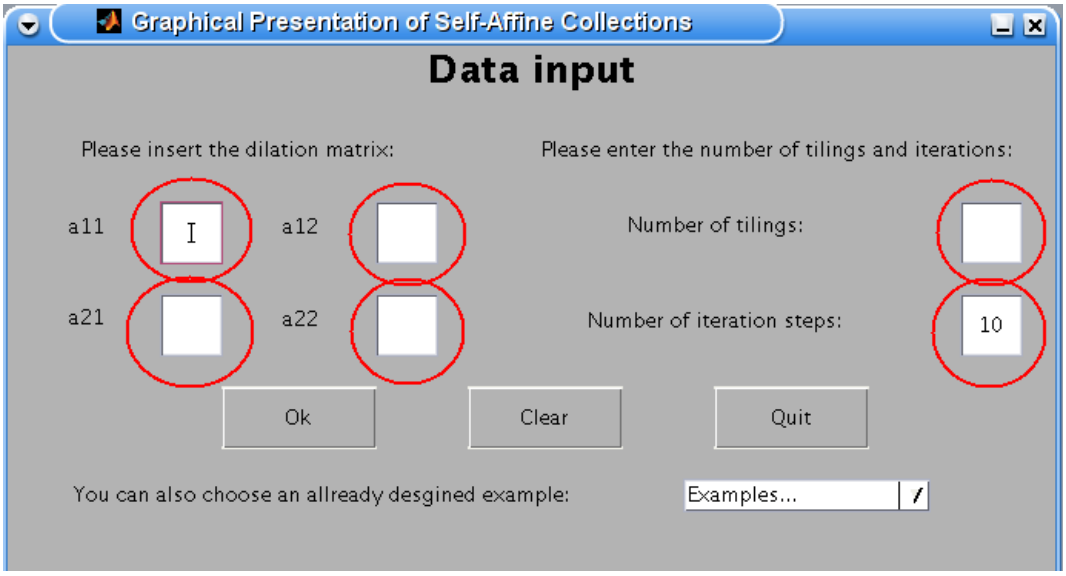


When you choose an example the corresponding values of the dilation or expanding matrix A, the number of tilings m and the number of digit sets as well as their elements are filled in the right sets.
Last you have to choose a number of iteration steps and click the “Plot Graphic” Button at the bottom of the GUI.



5. Enter own values

If you don't want to plot one of the examples, you can tell the program all relevant values on your own.
In the first step the entries of the dilation or expanding matrix A, the number of tilings and the number of iteration steps (the default value is 10) have to be given.

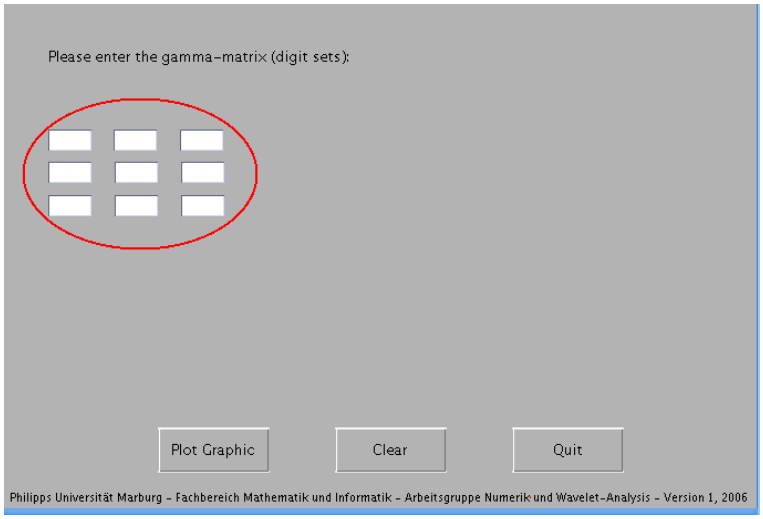


Please remember that the entries of A must be integer values. For m you can choose any integer between 1 and 9. The number of iteration steps must be a positive integer. You can clear the values any time by clicking the "Clear"-Button or exit the program by clicking the "Quit"-Button.

You confirm your entries with the "Ok"-Button (after your confirmation these values can't be changed anymore).

If you gave an invalid value to the program, you get a specific information about it on the matlab command window!

When all your entries are valid, an array of empty sets becomes visible in the lower part of the GUI.



The highlighted array represents the matrix $\Gamma = \left(\Gamma_{ij}\right)_{i,j=1}^{m}$ of digit sets. The numeration of the sets is not plotted out, but follows the usual matrix notation, in the case $m = 2$ we have

$$\Gamma = \begin{pmatrix} \Gamma_{11} & \Gamma_{12} \\ \Gamma_{21} & \Gamma_{22} \end{pmatrix}$$

for example.

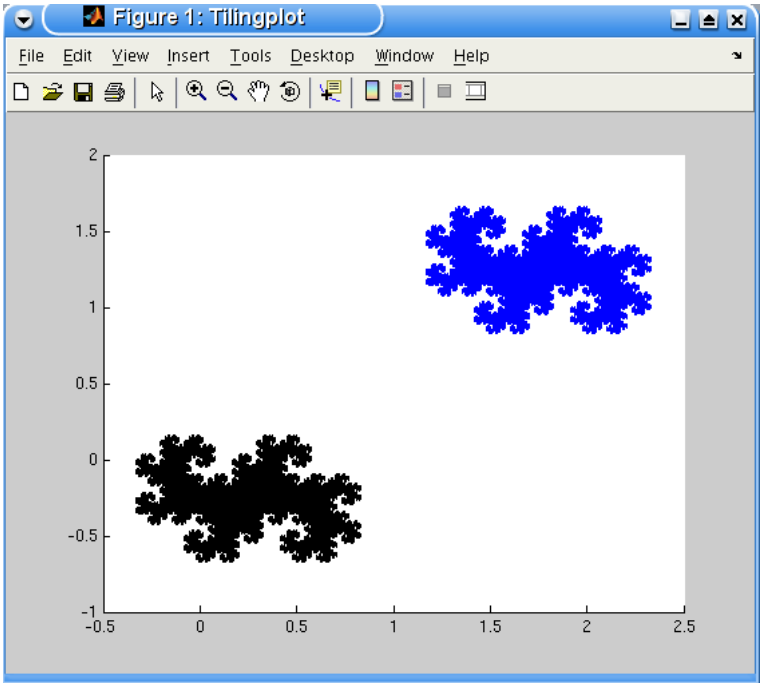
If you want to clear your values, you can use the “Clear”-Button. This will only clear the digit sets, but not the other values given above.

You can quit the program by using the “Quit”-Button.

The required format of the digit sets is

$$x_1,y_1;x_2,y_2;x_3,y_3;\ldots$$

(white spaces are ignored), so for example “0,0;1,0” is a valid entry, but not “1,1,2,1”.
The entries are expected to be integer values.
When your entries are not valid, you get an information on the matlab command window.
By clicking on the “Plot Graphic” Button the calculation of the tilings is started and the resulting sets are plotted in a second window.



6. Required time exposure

The following table gives you an imagination of the program run-time. For the five examples Twin Dragon, Double Twin Dragon, Divided Twin Dragon, Scorpion and Giant Hydra you find the program run-time from the point on you press the “Plot-Graphic”-Button. This is essentially the time period required for calculating the resulting sets and referring them to the graphical output.
Please remark that your system may need additional time to build and show graphic window for the output.
The calculation was performed with Matlab 7.0.1.24704 (R14) on a Linux System, Version 2.6.15.6, with an Intel® Pentium® 4 CPU, 1.80GHz.

Example	Number of iteration steps				
	5	10	12	13	15
Twin Dragon	0,126s	0,149s	0,311s	1,400s	2,015s
Double Twin Dragon	0,214s	0,251s	0,527s	0,805s	2,670s
Divided Twin Dragon	0,204s	0,304s	0,574s	0,817s	2,516s
Scorpion	0,175s	0,247s	0,440s	0,764s	2,557s
Giant Hydra	0,147s	3,830s	34,32s	114,85s	>15min

Literatur: [GrHaRa]: Gröchenig, Karlheinz, Haas, Andrew and Raugi, Albert: *Self-Affine Tilings with Several Tiles, I*, in: Applied and Computational Harmonic Analysis, **7** (1999), p. 211-238.