

rdex-website

Claude Heiland-Allen

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1 freesoftware.png

Freedom 0: The freedom to run the program for any purpose.

Freedom 1: The freedom to study how the program works, and change it to make it do what you wish.

Freedom 2: The freedom to redistribute copies so you can help your neighbor.

Freedom 3: The freedom to improve the program, and release your improvements (and modified versions in general) to the public, so that the whole community benefits.

2 goto10.png

goto10

3 index.html

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN" "http://www.w3.org/TR/
  ↪ xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
  <head>
5    <meta http-equiv="Content-Type" content="text/html; charset=UTF-8" />
    <title>rdex</title>
    <link rel="stylesheet" type="text/css" href="rdex.css" title="rdex" />
```

```

    <link rel="shortcut icon" type="image/vnd.microsoft.icon" href="rdex.ico" />
</head>
10 <body><div id="page">
    <h1><a href="." title="rdex"></a></h1>
    <h2><a href="." title="reaction-diffusion explorer"></a></h2>

    <div class="section" id="news">
15 
    <h3><a href="#news">News</a></h3>
    <p>

        <strong>rdex</strong> installation at
20 <a href="http://www.kibla.org/en/news/news/?no_cache=1&tx_ttnews[
      ↙ tt_news]=1343" title="Kiblix">Kiblix</a>!
        Come visit the KiBela gallery at Kibla MMC, Maribor, Slovenia from
        Thursday-Saturday 12th-14th November 2009.

    </p><p>
25 Or check out the <strong>rdex-server</strong> online here at
    <a href="/kiblix/" title="rdex :: kiblix">/kiblix/</a> during and
    after the festival.

30 </p></div>

    <div class="section" id="client">
    
    <h3><a href="#client">rdex-client</a></h3>
35 <p>

        <strong>rdex-client</strong> is an installation that explores in
        an autonomous hyperspace mathematical model, searching for
        interesting emergent behaviour (life-alike, alife).
40 </p><p>

        The model is a kind of continuous non-linear cellular automaton,
        based on partial differential equations representing chemistry
45 of two reagents involving reaction and diffusion.

    </p><p>

        The mathematical equations of the model have four parameters, that
50 need to be set to concrete values when running the simulation.
        <strong>rdex-client</strong> explores this 4D parameter space at
        random.

    </p><p>
55 <strong>rdex-client</strong> analyses the behaviour that emerges
        from the system, moving on to a new set of parameters if it fades
        into unchanging uniformity or explodes into erratic numerical
        instability. Much more time is spent evolving the cellular
60 automaton when neither of those alternatives occurs: when it finds
        something really quite interesting...

```

```

        </p><p>
65         Keywords: emergent behaviour, artificial chemistry, hyperspace
            exploration

        </p><p>

70         Video: <a href="http://www.archive.org/details/ClaudiusMaximus--rdex_2009-11-01" title="rdex 2009-11-01">rdex 2009-11-01</a>

        </p></div>

        <div class="section" id="server">
75         
        <h3><a href="#server">rdex-server</a></h3>
        <p>

            When <strong>rdex-client</strong> finds interesting behaviour, it
80            uploads a snapshot to <strong>rdex-server</strong> along with the
            results of a few image analysis algorithms. The most recent
            interesting patterns found by <strong>rdex-client</strong> are
            shown at the top of the page.

85        </p><p>

            <strong>rdex-server</strong> provides an interface to browse this
            collection by similarity to a chosen target or focus point. The
            target is shown full size on the left of the page, with the most
90            similar patterns displayed to the right.

        </p><p>

            The default metric is to choose <strong>nearby</strong> points in
95            the input 4D parameter space. The <strong>colour</strong> metric
            compares the resulting images' colour histograms.

        </p><p>

100         The <strong>texture</strong> metric compares some output pattern
            texture features (namely coarseness, contrast, and
            directionality for each of U and V). Finally the
            <strong>segment</strong> metric compares the sizes of
            contiguous regions in the output pattern.
105        </p><p>

            Keywords: data mining, image similarity, hyperspace exploration

110        </p></div>

        <div class="section" id="related">
        
        <h3><a href="#related">Related Work</a></h3>
115        <p>

            Reaction-diffusion chemistry has been a rich territory for artistic
            vs scientific investigation, from

```

```

120      Roy Williams ' 1994
      <a href="http://www.mrob.com/pub/comp/xmorphia/" title="Xmorphia">Xmorphia ↵
        ↵ </a>
      brought back to life and extended by Robert Munafo (excerpt pictured); ↵
        ↵ through to
      Hans H. Diebner 's 2009
      <a href="http://diebner.de/installations/EmergatForma.en.shtml" title="Ex ↵
        ↵ Omnium Rerum Perturbatio Emergat Forma">Ex Omnium Rerum Perturbatio ↵
        ↵ Emergat Forma</a>.

125    </p></div>

    <div class="section" id="mathematics">
    
    <h3><a href="#mathematics">Mathematics</a></h3>
130    <p>

        <strong>rdex-client</strong> models a
        <a href="https://en.wikipedia.org/wiki/Reaction%E2%80%93diffusion_system" ↵
          ↵ title="Reaction-diffusion system">reaction-diffusion system</a>,
        specifically the Gray-Scott reaction (equation pictured). The simple
135    rules can lead to complex emergent behaviour similar to that described
        in Stephen Wolfram 's
        <a href="http://www.stephenwolfram.com/publications/articles/ca/84-↵
          ↵ universality/" title="Universality and Complexity in Cellular ↵
          ↵ Automata">Universality and Complexity in Cellular Automata</a>.

    </p></div>

140    <div class="section" id="technology">
    
    <h3><a href="#technology">Technology</a></h3>
    <p>

145    <strong>rdex-client</strong> is written in
        <a href="http://en.wikipedia.org/wiki/C_(programming_language)" title="C">↵
          ↵ C</a> using
        <a href="http://en.wikipedia.org/wiki/OpenGL" title="OpenGL">OpenGL</a> ↵
          ↵ with
        <a href="http://en.wikipedia.org/wiki/GLSL" title="GLSL">GLSL</a>, as well ↵
          ↵ as
150    <a href="http://en.wikipedia.org/wiki/CURL" title="CURL">CURL</a> and
        <a href="http://en.wikipedia.org/wiki/POSIX_Threads" title="POSIX Threads ↵
          ↵ ">POSIX Threads</a>.

    </p><p>

155    <strong>rdex-server</strong> is written in
        <a href="http://en.wikipedia.org/wiki/Python_(programming_language)" title ↵
          ↵ ="Python">Python</a> using
        <a href="http://en.wikipedia.org/wiki/Web_Server_Gateway_Interface" title ↵
          ↵ ="WSGI">WSGI</a> within
        <a href="http://en.wikipedia.org/wiki/Apache_HTTP_Server" title="Apache ↵
          ↵ HTTP Server">Apache HTTP Server</a>, as well as
        <a href="http://pythonpaste.org/webob/" title="WebOb">WebOb</a>,
160    <a href="http://en.wikipedia.org/wiki/Python_Imaging_Library" title=" ↵
          ↵ Python Imaging Library">PIL</a>, and

```

```

    <a href="http://en.wikipedia.org/wiki/MySQL" title="MySQL">MySQL</a>.

</p></div>

165 <div class="section" id="freesoftware">
    
    <h3><a href="#freesoftware">Free Software</a></h3>
    <p>

170         <strong>rdex</strong> is
        <a href="http://www.fsf.org/about/what-is-free-software" title="free ↵
            ↵ software">free software</a>.

    </p></div>

175     <strong>rdex-client</strong> uses
    <a href="http://www.gnu.org/licenses/gpl.html" title="GNU General Public ↵
        ↵ License">GPLv3+ license</a>
    (<a href="http://code.mathr.co.uk/rdex-client" title="rdex-client source ↵
        ↵ code">rdex-client source code</a>).
    <br />
    <strong>rdex-server</strong> uses
180     <a href="http://www.gnu.org/licenses/agpl.html" title="GNU Affero General ↵
        ↵ Public License">AGPLv3+ license</a>
    (<a href="http://code.mathr.co.uk/rdex-server" title="rdex-server source ↵
        ↵ code">rdex-server source code</a>).
    <br />
    <strong>rdex website</strong> uses
    <a href="http://www.gnu.org/licenses/fdl.html" title="GNU Free ↵
        ↵ Documentation License">GFDLv1.3+ license</a>
185     (<a href="http://code.mathr.co.uk/rdex-website" title="website source code ↵
        ↵ ">rdex website source code</a>).

    </p></div>

    <div id="footer">
190     <span id="goto10"><a href="http://goto10.org" title="GOTO10"></a></span>
    <span id="author">
        rdex &copy; 2008,2009 <a href="http://mathr.co.uk" title="Claude Heiland-↵
            ↵ Allen">Claude Heiland-Allen</a>
    </span>
    </div>

195 </div></body>
</html>

```

4 mathematics.png

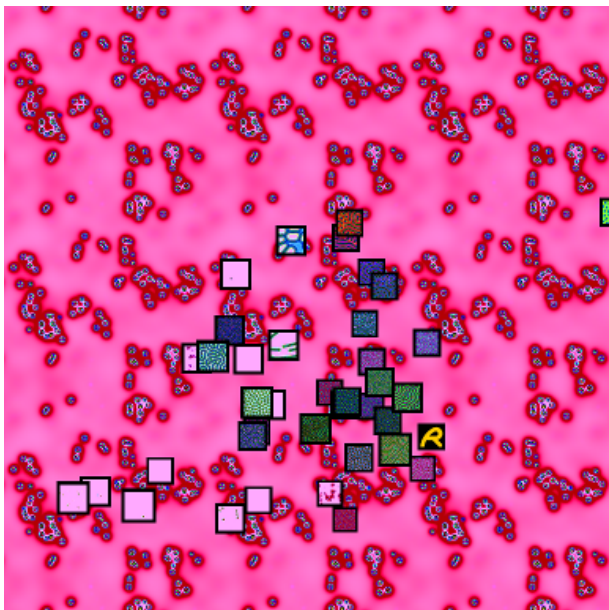
$$\frac{\partial u}{\partial t} = D_u \nabla^2 u - uv^2 + F(1 - u),$$

$$\frac{\partial v}{\partial t} = D_v \nabla^2 v + uv^2 - (F + k)v.$$

5 news.png



6 rdex-client.png



7 rdex.css

```
html, body, div, h1, h2, h3, h4, h5, h6, table, tbody, tr, th, td, a, img, dl, ↵
  ↵ dt, dd {
    margin: 0px;
    border: 0px;
    padding: 0px;
5    text-decoration: none;
  }

html, body {
  background-color: white;
10  color: black;
}

body {
  text-align: center;
15 }

div#page {
  width: 1024px;
```

```
margin-left: auto;
20  margin-right: auto;
    margin-top: 8px;
    margin-bottom: 8px;
    text-align: left;
}
25
div.section {
    clear: both;
    margin-top: 8px;
}
30
div.section img {
    float: left;
    width: 384px;
    height: 384px;
35  background-color: #cccccc;
    margin-top: 8px;
    margin-right: 8px;
    margin-bottom: 8px;
}
40
div.section#news img,
div.section#related img,
div.section#mathematics img,
div.section#technology img,
45 div.section#freesoftware img {
    height: 128px;
}

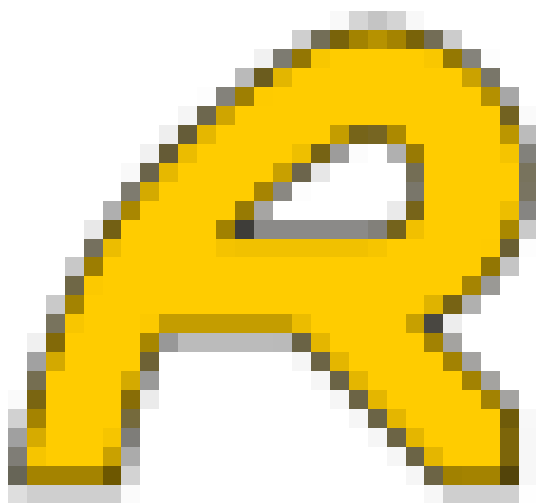
h1, h2 {
50  float: left;
    width: 128px;
    height: 128px;
    line-height: 128px;
}
55
h3 {
    height: 32px;
    line-height: 32px;
    margin-top: 8px;
60  margin-bottom: 8px;
}
p {
    margin-top: 8px;
    margin-bottom: 8px;
65 }

div#footer {
    clear: both;
    width: 1024px;
70  height: 32px;
    line-height: 32px;
}

span#author {
75  float: right;
```

```
}  
span#goto10 {  
    float: left;  
}
```

8 rdex.ico



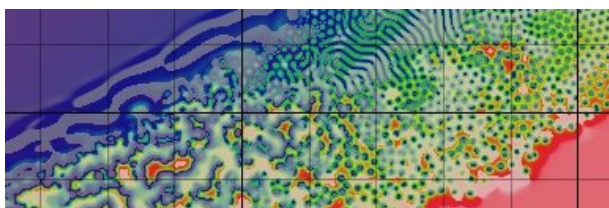
9 rdex.png



10 rdex-server.png



11 related.png



12 technology.png

```

29 float u = c.r;           // compute some temporary
30 float v = c.g;           // values which might save
31 float lu = l.r;          // a few GPU cycles
32 float lv = l.g;
33 float uvv = u * v * v;
34 //=====
35 float du = ru * lu + uvv + f * (1.0 - u); // Gray-Scott equation
36 float dv = rv * lv + uvv + (f + k) * v; // diffusion+reaction
37 //=====
38 u += 0.6*du; // semi-arbitrary scaling (reduces blow-ups?)
39 v += 0.6*dv;
40 gl_FragColor = vec4(clamp(u, 0.0, 1.0), clamp(v, 0.0, 1.0), 0.0, 1.0);
41 }
42

```

13 title.png



14 title.svg

```

<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<svg xmlns="http://www.w3.org/2000/svg" xmlns:xlink="http://www.w3.org/1999/
  ↳ xlink" width="182" height="26">
<defs>
  <filter id="Stroke" filterUnits="objectBoundingBox" x="-10%" y="-10%" width=
    ↳ ="150%" height="150%">
5    <feMorphology in="SourceGraphic" radius="0.5" operator="dilate" result="
      ↳ dilated" />
    <feColorMatrix type="matrix" values="0 0 0 0 1 0 0 0 0 1 0 0 0 0 1 0 0 0 1
      ↳ 0" in="SourceGraphic" result="black" />
    <feMerge><feMergeNode in="dilated" /><feMergeNode in="black" /></feMerge>
  </filter>
</defs>
10 <g>
  <rect x="0" y="0" width="182" height="26" fill="#ffffff" />
  <g stroke="black" stroke-width="0.2">
    <path fill="#cccccc" fill-rule="evenodd" d="M 0.2 6.5 L 178.732 6.5 A 14.534
      ↳ 14.534 0 0 1 178.732 19.5 L 0.2 19.5 A 14.534 14.534 0 0 0 0.2 6.5 Z" />
    <text fill="#ffffff" filter="url(#Stroke)" text-anchor="middle" x="90" y=
      ↳ ="14.25" font-size="5" font-family="Courier">(reaction-diffusion
        ↳ explorer)</text>
15  </g>
  </g>
</svg>

```