Embedding Visualization Applications with PyGR

Object oriented interfaces and PyQt/PySide bindings for GR - a universal framework for visualization applications

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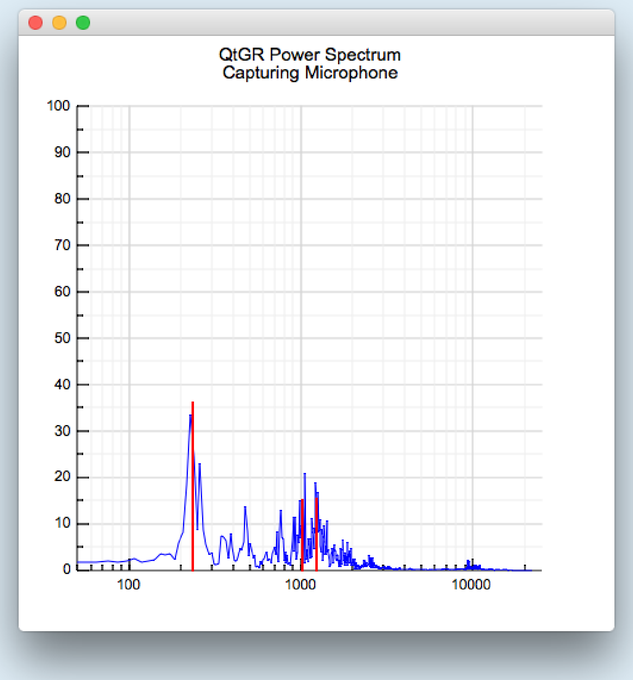
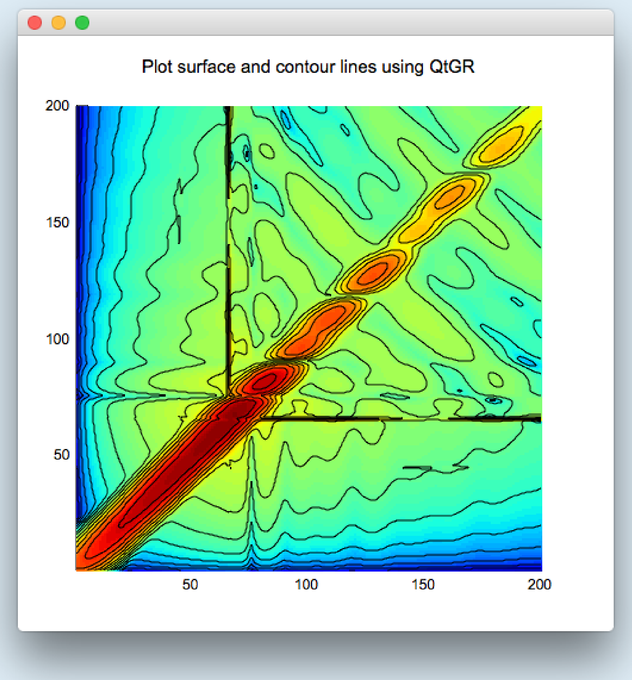
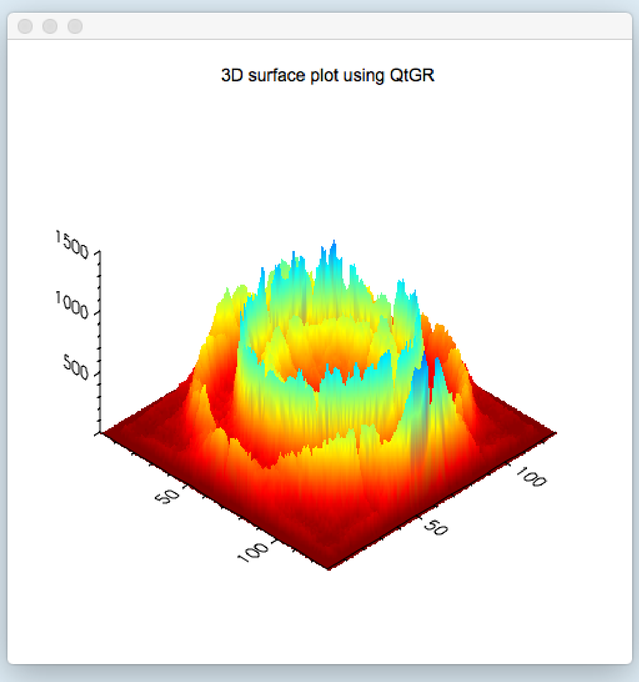


(a) Microphone Power Spectrum and Peaks (computed using FFT)



(b) Surface Plot with Contour Lines



(c) 3D Surface Plot

GR

- GRaphics Library optimized for real-time data visualizations
- Procedural graphics backend (written in C)
  - Does not rely on creation of figures

  ⇒ Representation of continuous data streams
- Based on a Graphical Kernel System
  - Device and Platform independent API
  - Large scale of logical device drivers/plugins:
    - Qt, wxWidgets
    - X11, Quartz, Win32
    - PostScript, PDF, SVG
    - GS (BMP, JPEG, PNG, TIFF)
    - MOV (MPEG4)
    - HTML5
- Builtin support for 2D plotting and OpenGL (GR3)

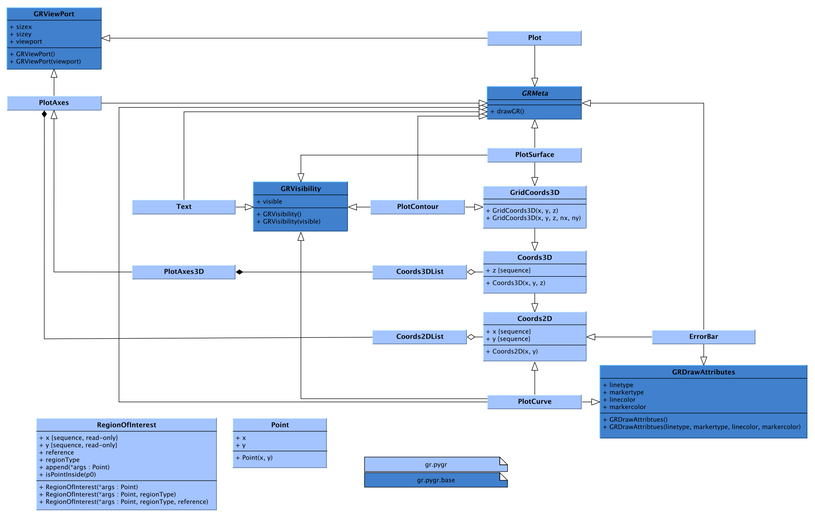
  ⇒ Coexistent 2D and 3D world

QtGR

- Qt Widgets for drawing and interacting with GR
- Specialized Qt Events, e. g. Mouse Events in different coordinate systems (Normalized-, Device- and World Coordinates)
  - MouseEvent
  - WheelEvent
  - PickEvent
  - ROIEvent
  - LegendEvent
- Support for PyQt and PySide

PyGR

- Object oriented interface on top of GR
- Convenience functions for
  - Zooming
  - Panning
  - Selecting a Region
  - Detecting predefined *Regions Of Interest* (point in polygon test)
- Independent of GUI Toolkits



- Manipulating object states instead of fiddling with procedure calls
- Adding new functionality using derived objects, e.g.
  - Clamp minimum values for selecting a *Region of Interest* ($x_{min}, y_{min} > 0$)

```
class ContourAxes(PlotAxes):

    def setWindow(self, xmin, xmax, ymin, ymax):
        if xmin < 1:
            xmin = 1
        if ymin < 1:
            ymin = 1
        return PlotAxes.setWindow(self, xmin, xmax, ymin, ymax)
```

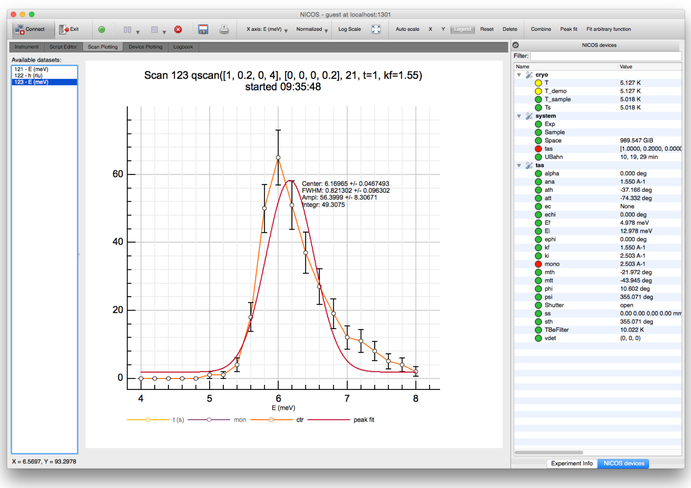
  - Drawing a bar at a given position x_i, y_i to indicate a peak position

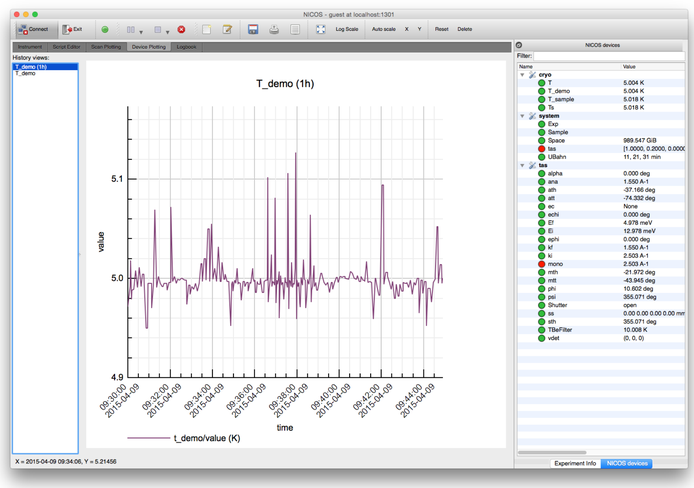
```
class PeakBars(PlotCurve):

    def drawGR(self):
        if self.linetype is not None and self.x:
            # preserve old values
            lcolor = gr.inqlinecolorind()
            gr.setlinewidth(2)
            gr.setlinecolorind(self.linecolor)

            for xi, yi in zip(self.x, self.y):
                gr.polyline([xi, xi], [0, yi])

            # restore old values
            gr.setlinecolorind(lcolor)
            gr.setlinewidth(1)
```

  - Hide/Unhide dependent objects

```
class DependentPlotCurve(PlotCurve):

    # Constructor...
    # dependent property...

    # pylint: disable=W0221
    @PlotCurve.visible.setter
    def visible(self, flag):
        PlotCurve.visible.__set__(self, flag)
        for dep in self.dependent:
            dep.visible = flag

    def drawGR(self):
        PlotCurve.drawGR(self)
        for dep in self.dependent:
            if dep.visible:
                dep.drawGR()
```

GR has been integrated into NICOS, a network-based experiment and instrument control system used for neutron scattering experiments at FRM II in Munich.





NICOS
Network Instrument COntrol System

- Replaced existing Panels
  - based on PyQwt (unmaintained)
- Auto scaling in x- and/or y- direction
  - Adjust axes to fit all shown curves including error bars
  - Adjust in respect to user specified region of interests

    → Adjust axes in altering direction only
- Support for different x axes
- Fitting Peaks or arbitrary functions
  - Picking of fit parameters

- Logarigthmic scale
- Dynamic tick marks for different time domains
- Legend items for curves
  - Un/hide curve and dependencies, e.g. error bars or fit parameters
- General purpose functions:
  - Zooming into a specific point (Mouse wheel zoom)
  - Panning
  - Selecting a *Region of Interest*

Ongoing Projects

- General purpose 3D plotting objects in PyGR
- Integrated live view for three-dimensional data
- Generation of SVG plots for HTML status monitor

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