cartesian_pe_testing

July 7, 2015

In [1]:
```
from __future__ import division
%matplotlib inline
```

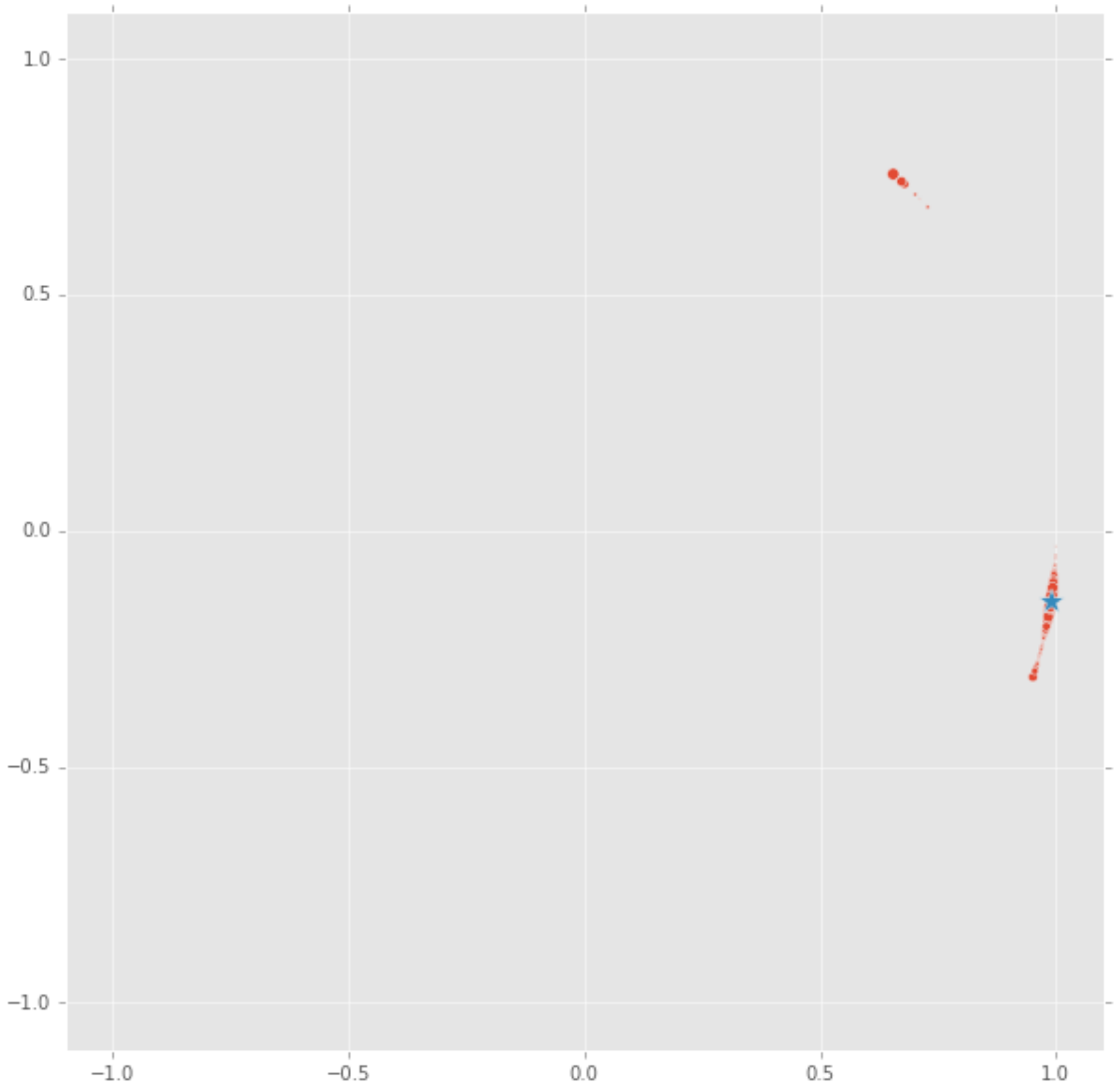
In [2]:
```
import numpy as np
import qinfer as qi
```

In [3]:
```
from functools import partial
```

In [4]:
```
import matplotlib.style
matplotlib.style.use('ggplot')
import matplotlib.pyplot as plt
```

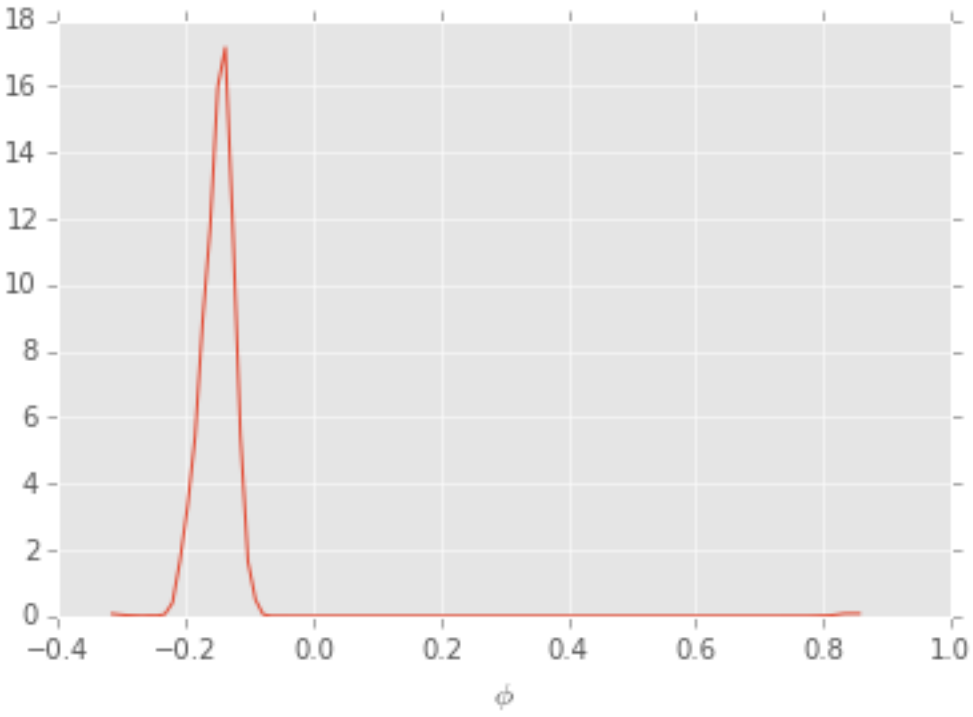
In [5]:
```
class CartesianPhaseEstimationModel(qi.Model):
    @property
    def n_modelparams(self): return 2
    @property
    def modelparam_names(self): return ["x", "y"]
    @property
    def is_n_outcomes_constant(self): return True
    @property
    def expparams_dtype(self): return [
        ('m', int), ('theta', float)
    ]

    def n_outcomes(self, expparams): return 2
    def are_models_valid(self, modelparams):
        return np.ones((modelparams.shape[0], ), dtype=bool)

    def likelihood(self, outcomes, modelparams, expparams):
        super(CartesianPhaseEstimationModel, self).likelihood(
            outcomes, modelparams, expparams
        )

        x, y = (modelparams.T)[..., None]
        m    = expparams[None, ...]['m']
        th   = expparams[None, ...]['theta']

        pr0 = np.zeros((modelparams.shape[0], expparams.shape[0]))

        pr0[:, :] = (1 + np.cos(m * (np.arctan2(y, x) - th))) / 2

        return qi.Model.pr0_to_likelihood_array(outcomes, pr0)

    def canonicalize(self, modelparams):
        return modelparams / np.linalg.norm(modelparams, 2, axis=1)[:, None]
```

```
In [6]: class UnitCirclePrior(qi.Distribution):
            @property
            def n_rvs(self): return 2

            def sample(self, n=1):
                th = np.random.random((n,)) * 2 * np.pi
                return np.array([
                    np.cos(th), np.sin(th)
                ]).T

In [7]: PhaseEstimationPGH = partial(qi.PGH,
            inv_field='theta',
            inv_func=lambda x_: np.arctan2(x_[:, 1], x_[:, 0]),
            t_field='m', t_func=np.ceil,
            other_fields={'n_meas': 1}
        )

In [8]: prior = UnitCirclePrior()

In [9]: model = qi.BinomialModel(CartesianPhaseEstimationModel())

In [10]: true_phase = prior.sample()
         updater = qi.smc.SMCUpdater(model, 1000, prior)
         heuristic = PhaseEstimationPGH(updater)

In [11]: for idx_experiment in xrange(20):
             experiment = heuristic()
             outcome = model.simulate_experiment(true_phase, experiment)
             updater.update(outcome, experiment)

In [12]: np.arctan2(*reversed(updater.est_mean()))

Out[12]: -0.14765645348090708

In [13]: np.arctan2(*reversed(true_phase[0]))

Out[13]: -0.14970710485802322

In [14]: plt.figure(figsize=(10, 10))
         plt.scatter(*updater.particle_locations.T,
             c=plt.rcParams['axes.color_cycle'][0],
             s=1000*np.sqrt(updater.particle_weights)
         )
         plt.scatter(true_phase[0, 0], true_phase[0, 1],
             c=plt.rcParams['axes.color_cycle'][1],
             marker='*',
             s=200
         )
         plt.xlim(-1.1, 1.1)
         plt.ylim(-1.1, 1.1)
         plt.gca().set_aspect('equal')
```



In [15]:
```
particle_phases = np.arctan2(*reversed(updater.particle_locations.T))
true_phase_phase = np.arctan2(*reversed(true_phase.T))
```

In [16]:
```
# This is a bloody awful hack to reuse updater.plot_posterior_marginal. Don't do this!
old_locs = updater.particle_locations
updater.particle_locations = particle_phases[:, None]
updater.plot_posterior_marginal(idx_param=0)
plt.xlabel(r'$\phi$')
updater.particle_locations = old_locs
```


18
16
14
12
10
8
6
4
2
0
−0.4
−0.2
0.0
0.2
0.4
0.6
0.8
1.0
ϕ