1 Potential Function

We break this up into a quadratic and linear section

- Quadratic is good because the derivative at 0 is 0
- Linear is good because it gives bounds to the speed as we get farther away
The negative gradient of the potential gives us the force.

# 2 Localization with Probabilistic Filters

<table>
<thead>
<tr>
<th>Filter</th>
<th>Motion Model</th>
<th>Measurement Model</th>
<th>State Distribution Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discrete Bayes</td>
<td>discrete distribution</td>
<td>continuous or discrete</td>
<td>Table or list of probabilities</td>
</tr>
<tr>
<td></td>
<td>(evaluated)</td>
<td>(evaluated)</td>
<td>for each discrete state</td>
</tr>
<tr>
<td>Particle</td>
<td>continuous distribution</td>
<td>continuous or discrete</td>
<td>particle = sample from a</td>
</tr>
<tr>
<td></td>
<td>(sampled)</td>
<td>(evaluated)</td>
<td>continuous distribution</td>
</tr>
<tr>
<td>Kalman Filter</td>
<td>linear motion model with</td>
<td>linear motion model with</td>
<td>continuous, Gaussian</td>
</tr>
<tr>
<td></td>
<td>additive Gaussian noise</td>
<td>additive Gaussian noise</td>
<td></td>
</tr>
<tr>
<td>Extended Kalman</td>
<td>nonlinear motion model with</td>
<td>nonlinear motion model</td>
<td>continuous, Gaussian</td>
</tr>
<tr>
<td>Filter</td>
<td>additive Gaussian noise</td>
<td>with additive Gaussian</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>noise</td>
<td></td>
</tr>
</tbody>
</table>

All of these are called filters since they generally come from the DSP perspective and because they filter out bad sensor data.

# 3 Evidence Grid - Fuzzy Version of Occupancy Grid

Notation: $m^i = \text{cell } i$

```plaintext
for each cell $i$ do
    Store $\log \frac{P(m^i=\text{occupied})}{P(m^i=\text{empty})}$
end for
```

Why log odds:

- Monotonic, order preserving
- Combats underflow and overflow
- We don’t need to fuss with the normalizers $\eta$ since they cancel out
- Easy, adaptive update

# 4 SLAM

Simultaneous Localization And Mapping. This is a big chicken and egg problem for robotics since you need a good idea of your position to make a good map and a good map is necessary to find position.