Monte-Carlo Localization aka Particle Filter

Figure 8.11  Monte Carlo Localization, a particle filter applied to mobile robot localization.

Probabilistic Robotics. Thrun, Burgard, Fox, 2005
Particle Filter Algorithm

1: procedure PARTICLE_FILTER($X_{t-1}, u_t, z_t$)
2: Inputs
3: $X_{t-1}$ – The previous set of particles
4: $u_t$ – The control signal
5: $z_t$ – The sensor value
6: Output
7: $X_t$ – The updated set of particles
8: $\bar{X}_t = X_t = \emptyset$
9: $M = |X_{t-1}|$
10: for $m = 0$ to $M - 1$ do
11: $x_t^{[m]} = \text{sample\_motion\_model}(u_t, x_t^{[m]})$
12: $w_t^{[m]} = \text{measurement\_model}(z_t, x_t^{[m]})$
13: $\bar{X}_t = \bar{X}_t \cup \langle x_t^{[m]}, w_t^{[m]} \rangle$
14: for $m = 0$ to $M - 1$ do \hspace{1cm} ▷ Resampling
15: draw $i$ with probability $\propto w_t^{[i]}$
16: $X_t = X_t \cup \langle x_t^{[i]}, 1/M \rangle$

Based on Algorithm in Table 4.3 in Probabilistic Robotics. Thrun, Burgard, Fox, 2005
Grid Example
Sampling From the Motion Model
Measurement Models for Laser Range Finders