0.1 The Computation of Forward and Backward Variables \((\alpha, \beta)\)

The forward and backward variables \((\alpha, \beta)\)
\[
\alpha^{n,k}_\tau(i) = p(q_{n,\tau}^k = i|m_{n,0:\tau}, o_{n,1:\tau}, \Theta_n) \quad \text{and} \quad \beta^{n,k}_t(j) = \frac{1}{\prod_{\tau' = \tau} p(m^{k}_{n,\tau'-1}|h^{k}_{n,\tau',\Theta_n})} \sum_{i}^{Q_n} \alpha(q_{n,\tau-1}^k = i, m_{n,\tau-1}, o_{n,\tau-1}, q_{n,\tau}^k = i) \delta(q_{n,\tau}^k = j, m_{n,\tau}^k, o_{n,\tau}, q_{n,\tau}^k = j) \lambda(q_{n,\tau}^k = j, m_{n,\tau}^k)
\]

\[
\text{if } \tau = 0
\]
\[
\text{if } \tau > 0
\]

\[
\beta^{n,k}_t(j) = \sum_{i,j=1}^{Q_n} \alpha(q_{n,\tau-1}^k = i, m_{n,\tau-1}, o_{n,\tau-1}, q_{n,\tau-1}^k = j) \delta(q_{n,\tau-1}^k = i, m_{n,\tau-1}, o_{n,\tau-1}, q_{n,\tau}^k = j) \lambda(q_{n,\tau}^k = j, m_{n,\tau}^k)
\]

\[
\text{if } \tau = 0
\]
\[
\text{if } \tau > 0
\]

\[
p(m_{n,\tau}^k|h_{n,\tau}, \Theta_n) = \frac{1}{\prod_{\tau' = \tau} p(m^{k}_{n,\tau'-1}|h^{k}_{n,\tau',\Theta_n})} \sum_{i,j}^{Q_n} \alpha(q_{n,\tau-1}^k = i, m_{n,\tau-1}, o_{n,\tau-1}, q_{n,\tau}^k = j) \delta(q_{n,\tau}^k = i, m_{n,\tau}^k, o_{n,\tau}, q_{n,\tau}^k = j) \lambda(q_{n,\tau}^k = j, m_{n,\tau}^k)
\]

\[
\text{if } \tau = 0
\]
\[
\text{if } \tau > 0
\]
0.2 Search and Rescue Domain

![Finite State Machine Diagram]

Figure 1: A heuristic policy finite state machine for UGV constructed by domain experts.

References