Information diffusion as a control model

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1. Consider the discrete time step. Let $X_t = [p_1^{(t)}, \ldots, p_n^{(t)}]^\top$, where each $p_i^{(t)}$ denote the probability that node i has been activated by time step t.

2. For all pair of nodes i, j, $\alpha_{j,i}$ is a parameter modeling how frequent information spread from j to i. $\alpha_{j,i} = 0$ means no link.

3. Let $f(t_i|t_j; \alpha_{j,i})$ be the conditional likelihood of transmission from j to i. e.g., f can be the pdf of exp, pow, ray distributions.

4. $p_i^{(t+1)} = p_1^{(t)} + (1 - p_1^{(t)})\delta_i^{t+1}$, where δ_i^{t+1} denote the probability that node i is activated during t to $t+1$.

5. Let $F_i^{(t+1)}(t_j; \alpha_{j,i}) = \int_t^{t+1} f(t_i|t_j; \alpha_{j,i})\, \mathrm{d}t_i$. Notice these $F_i^{(t+1)}(t_j; \alpha_{j,i})$ can be precomputed. Let $F_i^{(t+1)}(j; \alpha_{j,i}) = \Sigma_{t_j=1}^t F_i^{(t+1)}(t_j; \alpha_{j,i}) \cdot Pr(\text{j is activated at } t_j)$. Then, $\delta_i^{(t+1)} = 1 - \Pi_{j \neq i}(1 - F_i^{(t+1)}(j; \alpha_{j,i}))$.

6. $Pr(\text{j is activated at } t_j)$ can be calculated from $X_1, \ldots, X_t$. Specifically, $Pr(\text{j is activated at } t_j) = p_j^{t_j} \Pi_{t<t_j}(1 - p_j^t)$.

7. Control inputs can be (1) observing some nodes be activated; (2) modifying $\alpha_{j,i}$.

8. Evaluation