Stability of Jackson Type Network Output

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Abstract

We consider an open Jackson type queueing network $\mathcal{N}$ with input epochs sequence $I = \{T_n^{(0)},\, n \geq 0\}$, $T_0^{(0)} = 0$, assume another input $\tilde{I} = \{\tilde{T}_n^{(0)}\}$ and denote

$$\delta_k = \mid \tilde{T}_k^{(0)} - T_k^{(0)} \mid,\ \Delta_0 = 0,\ \Delta_n = \max_{1 \leq k \leq n} \delta_k,\ n \geq 1.$$

Let $\{T_n\}$ and $\{\tilde{T}_n\}$ be the output points in network $\mathcal{N}$ and in modified network, $\tilde{\mathcal{N}}$ with input $\tilde{I}$, accordingly.

We study the long-run stability of the network output, establishing two-sided bounds for output perturbation via input perturbation. In particular, we obtain conditions that imply

$$\max_{k \leq n} \mid T_k - \tilde{T}_k \mid = o(n^{1/r})$$

with probability 1 as $n \to \infty$ for some $r > 0$. This result is also extended to continuous time.

We consider successively separate station (service node), tandem and feedforward networks. Then we extend stability analysis to general (feedback) networks and show that in our setting these networks can be reduced to feedforward ones. Similar stability results are also obtained in terms of the number of departures.

Application to a tandem network with the overloaded stations is considered.

Key words: Jackson-type queueing network, input perturbation, network output, long-run stability, renewal processes, overloaded stations

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