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EDITORIAL

Editorial introduction: Special issue for Stochastic Networks 2018

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This special issue contains a selection of papers by some of the invited speakers at *Stochastic Networks 2018*, which was held at the International Centre for Mathematical Sciences in Edinburgh, UK, on 25–29 June 2018.

The 2018 Stochastic Networks meeting was the thirteenth in this series of high-quality workshops, which began with a meeting organised by Peter Glynn and Thomas Kurtz at the University of Wisconsin, Madison, in 1987. These meetings have maintained a strong tradition of bringing together mathematicians and applied researchers who share an interest in stochastic network models, reflecting topics at the cutting edge as applications have emerged and developed over the years. They have also become one of the key international forums at which the underlying theoretical and technical advances have been reported, discussed and developed. Since 2000, Stochastic Networks meetings have been held every two years. The 2020 meeting will be held at Cornell University; see https://blogs.cornell.edu/snc2020/ for details.

Stochastic Networks 2018 featured invited presentations from 20 internationally leading researchers, and posters presented by a further 25 participants. Together these represented cutting-edge developments on a wide variety of mathematical models, from queueing systems to random graphs, and in a diversity of application areas (including data centres, Bitcoin, energy, finance, healthcare and biological applications). A relaxed schedule allowed plenty of time for interactions between participants, and the excellent environment offered by ICMS was an ideal setting for these interactions. We are grateful for the work of the steering and programme committees, as well as the excellent local administrative support, which lead to such a successful meeting.

The papers in this special issue of QUESTA reflect the diversity of the high-quality work presented at *Stochastic Networks 2018*, across a range of topics and applications in the area.

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Mihail Bazhba, *Jose Blanchet*, *Chang-Han Rhee* and *Bert Zwart* establish large deviations tail asymptotics for the queue-length process of a $G/G/d$ queue in which service times have a Weibull-type distribution, with right tail given by $e^{-L(x)x^{\alpha}}$, where $0 < \alpha < 1$ and L is a slowly varying function. Their proof makes use of a recent large deviations principle for Lévy processes and random walks with heavy-tailed, Weibull-type increments. The asymptotics they establish illustrate an interesting trade-off between the number of large jobs and the size of these arriving large jobs when looking for the most likely way in which large queue sizes occur in this model; this is qualitatively different behaviour than that observed under other service time distributions.

In their paper, *Ellen Cardinaels*, *Sem C. Borst* and *Johan S. H. van Leeuwaarden* study the load balancing problem for a model in which there is affinity between arriving jobs and servers. That is, with each arriving job there is associated a set of primary servers, who may serve this job quickly and to one of which the job is assigned if any are available. Otherwise, the job is assigned to a slower, secondary server. These affinities may model, for example, geographic proximity between job arrivals and server locations. They establish stability conditions and performance bounds using a novel coupling construction giving a stochastic comparison between this system and others for which results are already available, including generalisations of Join-the-Shortest-Queue policies. Fluid limits are also analysed for particular instances of this affinity model satisfying certain symmetry conditions.

C. Drent, *S. Kapodistria* and *J. A. C. Resing* are motivated in their work by cost savings that are possible by coordination of maintenance and service of a network of resources, such as wind turbines. Maintenance of some of the resources in this network (made necessary by component failure, for example) may lead to opportunities for lower cost preventive maintenance on other resources, which may or may not restore components to ‘as good as new’. Using a semi-Markov decision process formulation of the problem, the optimal maintenance policy is derived under this model and the long-run cost rate is analysed. The authors focus on applications to networks of wind turbines, illustrating their results numerically using data from the wind energy industry.

Peter Gracar, *Arne Grauer*, *Lukas Lüchtrath* and *Peter Mörters* study an age-based spatial preferential attachment random graph model on the d-dimensional torus. This is a growing sequence of graphs in which vertices arrive in time according to a Poisson process and are placed uniformly at random in space. Edges are added between new vertices and old randomly, with a probability depending on the proximity of these vertices in space and in terms of their times of birth. They show that this sequence of graphs converges locally weakly to an age-dependent random connection model, and use this asymptotic structure to investigate characteristics of the age-based spatial preferential attachment model, including degree distribution, clustering coefficients and edge lengths. This model is motivated by the presence of clusters, leading to a graph which cannot be approximated locally by trees. Unlike other spatial preferential attachment models, which share this property, the model introduced here is simple enough to allow explicit analysis of features of interest, while maintaining the essential structure of the more complex models.

Remco van der Hofstad and *Harsha Honnappa* establish sharp tail asymptotics for componentwise maxima of bivariate Gaussian random vectors with an arbitrary correlation structure. Letting $X_1, X_2, \ldots$ be i.i.d. bivariate Gaussian random vectors and $\bar{X}_n = (\max_{1\le i\le n} X_i^{(1)}, \max_{1\le i\le n} X_i^{(2)})$ be the componentwise maximum, asymptotics are established for $\mathbb{P}(\bar{X}_n > a_n u)$. These asymptotics are established both for the case $a_n = \sqrt{\log n}$ and on the larger scale $a_n \gg \sqrt{\log n}$. Particular attention is paid to the interesting transition between the case where a single index causes both maxima and the case where different indices are responsible, and how this transition is related to the correlation structure of the underlying sequence of bivariate Gaussian random variables. This study is motivated by steady-state analysis of infinite-server queueing networks.

The work of *Justin A. Mulvany*, *Amber L. Puha* and *Ruth J. Williams* establishes the convergence of critical fluid model solutions for a multiclass processor sharing queue to the set of invariant states, uniformly for all initial conditions satisfying certain assumptions. This generalises earlier work by two of the authors in the single-class setting to the much more interesting and technically challenging multiclass setting. This relies on the novel definition of a relative entropy functional suitable for the multiclass case and will likely be a crucial step in proving heavy traffic diffusion approximations in this multiclass setting using state space collapse methodology.