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## INFORMS Journal on Computing 2002-2006 Test of Time Paper Award

1. INFORMS Journal on Computing 2002-2006 Test of Time Paper Award

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Alice Smith

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The Test of Time Award for papers published in the *INFORMS Journal on Computing* during the years 2002-2006 is awarded to:

**Joseph Abate and Ward Whitt**

*A Unified Framework for Numerically Inverting Laplace Transforms*

*INFORMS Journal on Computing, Volume 18, Number 4, 2006, 408-421*

**Test of Time Award Citation 2002-2006:**

This paper unifies methods for inverting Laplace Transforms. The importance of numerical methods for such inversions resulted in significant research, including an award-winning paper by the authors that appeared a decade before this work. In addition to introducing the framework, the authors show how three popular methods fit into it. The paper shows that different components can be combined to create algorithms that are more effective than individual methods. It continues to be cited by researchers who use it as a springboard for new methods.

**Retrospective comments on this paper from the authors, Joseph Abate and Ward Whitt:**

"Our selected 2006 *IJOC* paper, "A Unified Framework for Numerically Inverting Laplace Transforms", was the culmination of more than 20 years joint research, much in collaboration with Gagan L. Choudhury, Kin K. Leung and David M. Lucantoni (recognized by the Lanchester Prize Committee in 1998). In 1990 the two of us began studying algorithms for numerically inverting Laplace transforms and their application to stochastic models in operations research. We developed and analyzed candidate algorithms, as illustrated by our earlier papers in this journal: "Numerical Inversion of Laplace Transforms of Probability Distributions", 7 (1995) 36-43; "On the Laguerre Method for Numerically Inverting Laplace Transforms", 8 (1996) 413-427 (also with Gagan L. Choudhury); and "Computing Laplace Transforms for Numerical Inversion Via Continued Fractions", 11 (1999) 394-405.

For complex stochastic models, such as stochastic networks or polling models, special methods are needed in order to apply the inversion algorithms. Thus there are additional papers for specific classes of models. A tutorial survey appears in, "An Introduction to Numerical Transform Inversion and its Application to Probability Models", in *Computational Probability*, W. Grassman (ed.), Kluwer, Boston, 1999, pp. 257-323 (also with Gagan L. Choudhury).

By 2006, it was well established that there are several effective approaches to numerical transform inversion, but there was not a coherent unified story. The selected paper makes progress in that direction by introducing a general framework for inversion algorithms and showing how three classic inversion algorithms can be expressed in that framework. The key idea is recognizing that a function $f(t)$ can be approximated by a finite linear approximations of the transform values, depending on two sets of complex numbers, called nodes and weights, but independent of the argument $t$ and the Laplace transform of $f$, as shown in equation (2) of the paper. The algorithms differ by the way they specify the nodes and weights.

As shown in equation (5) of the paper, the representation extends directly to multivariate functions.

Moreover, different one-dimensional algorithms can be combined to create multivariate algorithms. We show that it can be more effective to combine different one-dimensional algorithms than repeat individual one-dimensional algorithms. "

This award considers all papers published in *INFORMS Journal on Computing* during the time window considered. I would like to gratefully acknowledge the award committee chaired by John Chinneck with

members Bill Cook, Bruce Golden, Pascal Van Hentenryck, and David Woodruff.

Alice Smith

Editor in Chief, *INFORMS Journal on Computing*

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