



**HAL**  
open science

# Stochastic Modeling by Inhomogeneous Continuous Time Markov Chains

Yan-Fu Li, Yan-Hui Lin, Enrico Zio

► **To cite this version:**

Yan-Fu Li, Yan-Hui Lin, Enrico Zio. Stochastic Modeling by Inhomogeneous Continuous Time Markov Chains. EURO Workshop on Stochastic Modelling, May 2012, France. hal-00737094

**HAL Id: hal-00737094**

**<https://centralesupelec.hal.science/hal-00737094>**

Submitted on 1 Oct 2012

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# Stochastic Modeling by Inhomogeneous Continuous Time Markov Chains

Y.F. Li<sup>1</sup>, Y.H. Lin<sup>1</sup>, E. Zio<sup>1,2</sup>

<sup>1</sup> *Chair on Systems Science and the Energetic Challenge, European Foundation for New Energy-Electricite' de France, at Ecole Centrale Paris-Supelec, France*

<sup>2</sup> *Politecnico di Milano, Italy*

**Abstract:** Homogeneous continuous time Markov chain (HCTMC), with the assumption of time-independent constant transition rates, is one of the most frequent applied methods for stochastic modeling. In realistic situations, with varying external factors influencing the transition processes, the transition rates can no longer be considered time-independent. Under these circumstances, the inhomogeneous CTMC (ICTMC) is more suited for modeling the stochastic processes. One drawback of ICTMC is that an analytical solution is difficult, if not impossible, to obtain. Then, one must resort to numerical approaches e.g. Monte Carlo simulation, uniformization, state-space enrichment, and numerical differential equation solvers. This presentation aims at comparing the methods, making reference to a simple but challenging case study.

**Keywords:** Inhomogeneous continuous time Markov chain, Runge-Kutta methods, uniformization, Monte Carlo simulation, state-space enrichment.