2ème colloque de la Chaire de recherche industrielle CRSNG/Hydro-Québec sur l'optimisation stochastique de la production d'électricité

Méthodes de gestion de la production hydroélectrique

2nd Colloquium of the NSERC/Hydro-Québec Industrial Research Chair on the Stochastic Optimization of Electricity Generation

Methods for Managing Hydroelectricity Generation

9 mai 2012 / May 9th, 2012

Salle / room 5441, Pavillon André-Aisenstadt, Université de Montréal

PROGRAMME / PROGRAM

13h45 Michel Gendreau, titulaire de la Chaire / Chairholder

Mot d'accueil – Welcome address

13h50 Kengy Barty, EDF

A comparison between two hydro-valley management tools

During his stay in our R&D department in EDF, A. Philpott has experimented a comparison between the tool he has developed DOASA, and our home made model. DOASA is an SDDP-like algorithm performed over a scenario tree; the difference with SDDP mainly arises from the way the simulation pass is executed. Our model is a simple dynamic programming, but since the number of reservoirs to manage is too large, this model manages only the head reservoir with dynamic programming, the rest of the valley is driven with à simple guide curve. The goal was to determine the preferable algorithm for a hydro-valley management problem.

14h15 Marco Latraverse , Pascal Côté, Bruno Larouche, Rio Tinto Alcan

Assessing the Value of Hydrological Ensemble Predictions for Rio Tinto Alcan's Hydropower System in Eastern Canada

Rio Tinto Alcan (RTA) is a multinational aluminum producer with smelters in Quebec, Canada. RTA also owns and operates power houses on Péribonka and Saguenay Rivers. The system, which is run by RTA's Quebec Power Operations Division, consists of 6 generating stations and 3 major reservoirs, for an installed capacity of 2900 MW. One of the significant issues that had to be resolved for effective operation of this system was to determine the volume of water release per week for all generating stations. Several challenges had to be dealt with before a

suitable solution could be found. Last year, RTA started a five year R&D project for improving the management of the hydropower system. This project includes data monitoring, hydrological ensemble prediction (HEP) and stochastic optimization methods.

We evaluated two different stochastic optimization approaches: lag-1 Stochastic Dynamic Programming (SDP) and Sampling Stochastic Dynamic Programming (SSDP) algorithms. Both stochastic optimization methods use Hydrological Ensemble Prediction (HEP) to capture the spatio-temporal variability of the inflows. This presentation investigates the value of using different HEP procedures in the operation of RTA's hydropower system with stochastic optimization methods. More precisely, the value of using biased or unbiased HEP, the value of using HEP with a good representation or a misrepresentation of the predictive uncertainties were assessed using a test bench study that mimics real-world RTA's operations. The results indicate that in real world operations, biased HEP or under-dispersed HEP can void the gain obtained by stochastic optimization methods.

14h40 Grégory Emiel, Hydro-Québec Production

Hydropower Reservoir Management at Hydro-Québec: from Mid-Term to Short-Term

In this talk we will give an overview of the main decision tools that are currently in use at HQP for hydro-production planning. We will also present ongoing developments that have been started in collaboration with two universities in Montreal in order to better take into account random parameters in the planning process.

15h05 Ziad Shawwash, Department of Civil Engineering, University of British Columbia

Optimizing the Operation of the BC Hydroelectric System: Overview of the Grant-in-Aid Research Program between BC Hydro and UBC

We present a number of models that we have developed under the Grant-in-Aid Agreement between BC Hydro and the Department of Civil Engineering at UBC. We first provide an overview of the BC Hydro system and then present our modeling framework and then discuss a number of optimization modeling tools that we have developed and are currently in use at BC Hydro and we briefly outline ongoing research and development work supported by BC Hydro and leveraged by an NSERC CRD grant.

15h30 Pause / Coffee break

16h00 Bernard F. Lamond, Pascal Lang, Operations & Decision Systems Department, Université Laval

Computing expected water value in hydropower systems using a bivariate stochastic model

We present a method for exact computation of the expected value of a nonseparable, piecewise linear function of two variables. We assume a stochastic model of two random variables obtained by linear combination of two independent principal components having gamma distributions with integer shape parameters. The method can be implemented so the computational effort is proportional to the number of piecewise affine pieces times the product of the shape parameters of the gamma distributions. It can be used for fast computation of expected values in stochastic dynamic programming. Numerical results are presented in the case of two reservoirs in series.

16h25 Raphael E.C. Gonçalves, CIRRELT / Chaire CRSNG/Hydro-Québec, Polytechnique

Stochastic aspects improvements in the models used in the Brazilian hydrothermal system operation: An academic view

The purpose of the presentation is to introduce some features of the Brazilian hydrothermal system, to give some idea about the research progress and to show the challenges regarding the use of stochastic programming in the Brazilian models, especially focusing on the Medium-term Operation Planning model.

16h50 Pierre-Luc Carpentier, CIRRELT / Chaire CRSNG/Hydro-Québec, Polytechnique

Application of a Benders decomposition algorithm with a recombining scenario tree for midterm generation scheduling

In this presentation, we consider Hydro-Québec's midterm hydro generation scheduling problem (MGSP). The aim is to find weekly reservoir release targets and hydro plants generation target over the coming 18-24 months. The MGSP is formulated as a large multistage stochastic linear program (MSLP). Reservoir inflow variability is modeled by a recombining scenario tree (RST). The solution method is inspired by Küchler and Vigerske (2007) nested Benders decomposition algorithm adapted for RSTs. This approach is tested on Hydro-Québec's power system with real-world data. Results are compared with Rockafellar and Wets progressive hedging algorithm (PHA).

17h15 Clôture / Closure