# PROPOSITION FOR INTERNSHIP

« Analysis and modeling of sewer network »

At the Research Public Center « Henri Tudor » a model predictive control based on optimization approach was developed and applied on waste-water network systems. Hereafter some elements set as objectives: regulation of the water volume in each tank in the network (V1, V2) related to a reference value that changes each day, ensure a constant flow oriented to the waste-water treatment plant (Out1 + Out2), limit the overflows for all tanks (Ov1, Ov2).

In the modeling phase, the method actually developed is based uniquely on quantitative information of the water: mass conservation principle for each tank, as well as the transport phenomena in the water pipes based on a delay transport approach.

In the following work, it will be interesting to take into account a qualitative information concerning the polluted discharge in the water that is transported in the network (CIn1, C_1, CIn2, C_2, C_3 and C_{out}) by considering dilution phenomena that can appear in the tank and at the interconnections. An important element is the behavior of the charges during powerful rain fall events. The final goal is to be able to minimize the charge overflow and not only the volume overflow.

$$Out_1 (t - T_1) + Out_2 (t - T_2)$$

$$T_1 = t_1 + t_0 + t_3$$
$$T_2 = t_2 + t_0 + t_3$$
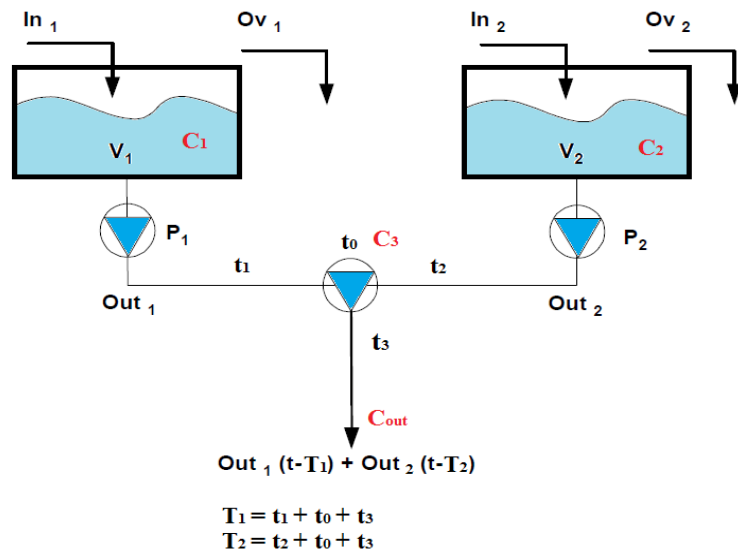
Le stage will be done at the modeling and simulation unit MODSI from AMS under the responsibility of Dr. Anca Maria NAGY-KISS

BRIEF DESCRIPTION

The internship consists in the analysis of the existing modeling and the predictive control approach in order to integrate in the model of sewer network some new variables concerning the charge concentrations.

THE INTERNSHIP WORK-FLOW

The used data for methods validation come from real process and simulated parts. The consumption scenarios used in the simulator are defined according to the order degree of the real flows. The same for the rainfall evolution.

After an introduction phase in the subject and familiarization with the model predictive control method based on optimization and with the model used, a qualitative analysis will be done. After a bibliographical research, a choice concerning the type of concentrations to consider will be realized.

Some mathematical relations must naturally be founded between these concentrations and the flows at different points in the network. Depending on the left time in the progress of the internship, another objective is to integrate new qualitative goals in the predictive control based on the new model that contains the concentrations.

In all previously presented phases, the programming tool principally used is MATLAB.

THE INTERNSHIP OBJECTIVES

1. Initiation in research work
2. Comprehension of modeling sewer network
3. Integration of the polluted charge in the existing model
4. Study of the relations between different variables of the new model
5. Comprehension of the predictive control method based on optimization
6. Work on industrial project with real and simulated data
7. Skill development in MATLAB

THE DEFENSE

The internship will be concertized by a report of the realized work and a presentation of the most important outcomes will be done at the AMS department from CRP Henri Tudor.

BIBLIOGRAPHY

[1] Strobl,R.O. ; Robillard, P.D. Network design for water quality monitoring of surface freshwaters: A review. *Journal of Environmental Management,* 87 (2008), 639–648.
[2] Gray, N. F. Drinking Water Quality: Problems and Solutions, Cambridge University Press, 2008
[3] Fiorelli, D. ; Schutz, G. Real-time control of a sewer network using a multi-goal objective function. *17th Mediterranean Conference on Control and Automation* (MED09), 2009.
[4] Fiorelli D., Mise au point d'un simulateur du future réseau de basins d'alimentation en eau potable de la commune de Wormeldange, prestation LTI-V-2008-2285,
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