ABSTRACT

In the last years it has been increasing the interest to improve the efficiency of the irrigated land channels. Traditionally, the management of the channels happened through a manual drive of the regulation elements. At the present time, the tendency is to introduce, more and more, elements of automatic control.

In this Tesina it’s shows a model of predictive control in real time, based on the linearization of the model of Saint-Venant near the reference trajectories, according to the perturbation theory. This lineared model becomes a system of equations that relates the trajectory of applied floodgate $U$ with the levels $Y$ that are obtained in the control point.

As starter data we have calculated the floodgate trajectories $U^*$ to implement in a channel during a day of irrigation of 24 hours for reaching certain instructions of level $Y^*$ in some sections of the channel. Such trajectories of floodgate and instructions are what we call reference trajectories.

When initiating the irrigated land day, in the case there is a nonpredicted perturbations, can be observed that at a determined instant of control $k$ the measures of $Y_m$ level are different from the anticipated trajectories of reference level $Y^*$ for this instant, so it takes place a desviation respect to the instruction $\Delta Y^*$.

The model of predictive control showed must be able to calculate in real time how to modify the position of the floodgate $\Delta U$ within the prediction horizon, with the purpose of reestablish the soon as possible the levels towards the instruction, by solving the system of equations obtained. The method of resolution used in this Tesina consists in an optimization process, based on one of the “Trust Region” methods. This problem, nevertheless, has to be solved at every instant of time $k$, because the only control action $U_a$ applied on the channel is the one that correspons at the instant $k + 1$.

In order to evaluate the capacity of the model to control the water flow in an altered channel by a perturbation, is considered a section of 2500m of length of a particular channel. As a upstream condition have been considered a vertical sliding floodgate that allows the passage of a certain volume $Q$ and that it connects with a reservoir of great dimensions, which allows to remain the level constant during the process. As a downstream condition it has been considered that the channel finishes with a wall and existance of a pumping station that is the one that extracts the demanded volume. The difference between the volume that arrives to this point and the volume of pumping will cause an oscillation of the level in this section and the controller will act consequently modifying the overture of the upstream floodgate.

In order to carry out this evaluation it is necessary to construct a numerical simulator that reproduces the section of the considering channel and that allows to introduce known and unknown perturbations, to avoid the necessity of using an experimental channel. This simulator is based on the discretización of the Saint-Venant equations with the method of the characteristics.

The only considered perturbation will be the extraction of a certain water volume not allowed by pumping, located in the intermediate point of the channel. To study a wide average of hydraulic situations, it will be tested three possible cases of the perturbation (impulse, step of short duration, and step long play) and different values of them.

In the graphics obtained from the results have been included the out going measurement of the levels $Y_m$, compared with the instruction $Y^*$, and the trajectories of floodgate applied to $U_a$, compared with the reference trajectory $U^*$, of each one of the made tests. From the made simulations it is possible to conclude that the model of predictive control is able to control perturbations as an impuls up to 30% of the circulating volume, perturbations as a short step duration up to 20% of the circulating volume, and perturbations as long step play up to 10%.