

## Hydraulic Performance of a Downstream Controlled Irrigation Canal Equipped with Different Offtake Types

Rijo M.<sup>1</sup> and Arranja C.<sup>2</sup>

<sup>1,2</sup> Hydraulics and Canal Control Centre, University of Évora, Apartado 94, 7002-554 Évora, Portugal, [rijo@uevora.pt](mailto:rijo@uevora.pt)<sup>1</sup>, [ca@uevora.pt](mailto:ca@uevora.pt)<sup>2</sup>

### ABSTRACT

Regarding canal management modernization, water savings and water delivery quality, the study presents two automatic canal control approaches of the *PI* (Proportional and Integral) type: the distant and the local downstream control modes. The two *PI* controllers are defined, tuned and tested using a hydraulic unsteady flow simulation model, particularly suitable for canal control studies. The *PI* control parameters are tuned using optimization tools. The simulations are done for a Portuguese prototype canal and the *PI* controllers are analyzed and compared considering a demand-oriented-canal operation.

The paper presents and analyzes the two control modes answers for five different offtake types – gate controlled weir, gate controlled orifice, weir with or without adjustable height and automatic flow adjustable offtake. The simulation results are compared using water volumes performance indicators (considering the demanded, supplied and the effective water volumes) and a time indicator, defined taking into account the time during which the demand discharges are effective discharges.

Regarding water savings, the simulation results for the five offtake types prove that the local downstream control gives the best results (no water operational losses) and that the distant downstream control presents worse results in connection with the automatic flow adjustable offtakes.

Considering the water volumes and time performance indicators, the best results are obtained for the automatic flow adjustable offtakes and the worst for the gate controlled orifices, followed by the weir with adjustable height.

**Keywords:** Irrigation canal, PI controller, downstream control, irrigation offtake, water saving, performance indicators.