Quantum Gravity 220.1: Bang−Bang and Switching Control

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From Osher Doctorow

In Bang−Bang Control in Optimal Control Engineering and Mathematics theory, the controller switches suddenly/abruptly between two states (see Wikipedia "Bang−Bang Control", "Hysteresis," etc.).

ArXix has 9 papers on Bang−Bang control including 1 in 2007 and 2 in 2006.

Switching Control is often closely related to Bang−Bang Control, and has 5 papers in arXiv including 1 in 2007 and 2 in 2006, but the wider category "Switching" in arXiv brings up 462 papers including 91 in 2007 and 94−95 in 2006. The papers have tended to increase in number from 1994 (3 papers) and 1995 and 1996 (3 papers each) to the 90s in 2006 and 2007.

An especially interesting paper arguably is Grace Y. Lin, Y. Yu, David Yao's "Stochastic knapsack problem revisited: switchover policies and dynamic pricing," arXiv:0708.1146 math.PR, math.OC (optimal control). The first 2 authors are at IBM T. J. Watson Research Center Yorktown Heights New York, the 3rd at Columbia U. New York. Switchover policies as defined/used by them start from accepting only orders of the highest price and switch to including lower prices as time goes by, the switchover time optimally decided by convey programming, and they show that such policies are asymptotically optimal.

Stochastic knapsack problems, as in Lin, Yu, and Yao (2007), are widely used in fields from dynamic resource allocation to admission control in telecommunication, and in recent years has become important in studying revenue management and dynmical/flexible pricing problems.

These types of papers arguably are often precedents for using Bang−Bang and Switching Control in physics, and cosmology should be no exception. The shifts from constant or decelerating to accelerating Universe or vice versa discussed in my recent posts seem similar to various of the scenarios of the Bang−Bang and Switching Control papers.

Many of these papers are related to hysteresis as I indicated earlier. Hysteresis is path−dependent memory basically, and you need the history of the input to predict the output, unlike Markov chains and Independent Probability−Statistics processes. Path−dependent memory belongs to Probable Causation/Influence (PI), while Markov chains belong to conditional probability, the two being respectively characterized by:

1) P(A−−>B) = 1 + y − x, 0 < = y < = x < = 1
2) P(B|A) = y/x, 0 < = y < = x < = 1 except that x not 0

In both (1) and (2), y = P(AB), x = P(A).

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