Study of the best linear approximation of nonlinear systems with non-Gaussian inputs

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System identification is the art of modelling of a process (e.g. physical, biological) or to predict its behaviour or output when the environment condition or parameter changes. In linear systems, changing an input parameter will result in a proportional increase in the system output. This is not the case in a nonlinear system. Linear system identification has been extensively studied, but this is not the case for nonlinear system identification. Most systems are nonlinear to some extent so there is significant interest in this topic as industrial processes become more and more complex.

In a linear dynamical system, knowing the impulse response function of a system will allow one to predict the output given any input. For nonlinear system this is more complex. If advanced theory is not available, it is possible to approximate a nonlinear system by a linear one. One tool is the Best Linear Approximation (BLA) which is an impulse response function of a linear system that minimises the output differences between its nonlinear counterparts. The BLA depends on the type of the input, more specifically, the power and the amplitude distribution. There is extensive literature on BLA obtained from input signals with a Gaussian probability density function, but there has been very little for other kinds of inputs. This thesis attempts to study the behaviour of the BLA with regards to other types of signal, and in particular, binary sequences where a signal takes only two levels. Such an input is valuable in many practical situations, for example modelling the behaviour of a switch or a valve which can only be turned either on or off.