Autonomous Ocean Bottom Seismometers Signal Transmission

Ocean bottom seismometers can be used in a wide number of fields within the Earth Sciences: from monitoring and analysis of seismicity and seismic hazard evaluation in margins, the seismic awareness and the control of the stability of the continental shelf, to the study of the structure and physical properties of the crust and the measure of stresses in civil engineering works. In order to actively progress in the new design of these underwater sensors (marine seismometers), we must critically consider all the previous measurements achieved with the available equipment. From these preceding results, we have already learnt many crucial aspects related to the reliability and robustness of the entire equipment which includes the mechanical structure, the electronic and the design of electronic-cartridge components: Optimisation signal/noise ratio, systematic signal processing, clock stability and time precision, On-line control, and the ability to protect the whole system including the recording packages when it moves down to the seafloor.

Up to 80% of the failures in submarine systems occur in the first three hours after deployment. Therefore, for long-term deployment, it is necessary to control the functioning of the system shortly after it has reached the sea bottom.

Moreover, the implementation of online monitoring will certainly increase the consistency of the system, and in many aspects, facilitate critical information to take *real time* decisions concerning logistics and possible reorganisation of the cruise, and hence increase the confidence and effectiveness of system.

The performance of the whole system obtained from previous testing and observations allows us to recognise the need for continuous communication between the marine platform and the sensor. Therefore, the new design will incorporate a device permitting permanent communication with the sensor whether it is undersea or at the surface. In this way it is possible to know its functioning and location at any moment. To achieve this objective it is essential to reduce power consumption and to evaluate (filter) the occurrence of reverberations and spreading on time and frequency.

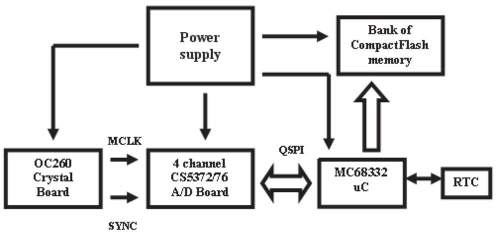


Figure: Acquisition system block diagram

Non-Smooth Bifurcations in Electronic

Abstract –One-parameter nonsmooth bifurcations occur in piecewise-smooth sets of ordinary differential equations. Motivated by applications, 'bifurcation' is defined as a nonsmooth transition with respect to a codimension-one discontinuity boundary in phase space. Only local bifurcations are considered, involving equilibria or a single point of boundary interaction along a limit cycle. Filippov systems are specially considered because its application in electronic circuits, as power electronic converters. A rich array of dynamics are revealed, involving the sudden creation or disappearance of attractors and bifurcation diagrams with sharp corners. An example of a variable structure circuit, which is a first step in designing a DC-DC converter, is studied with some detail.

Keywords – DC-DC Converters, Nonlinear Dynamics, Bifurcations.

1. Introduction

DC-DC converters are generally systems of Filippov type, where both two vector fields F and G are linear. Thus they provide good examples and applications of the theory which has been shown previously. In the scientific community it has been shown that a DC-DC Boost converter can exhibit several nonsmooth transitions [1]. Also several models of DC-DC Buck converter have been studied [2]. We review this example in the following, where several nonsmooth transitions are reported. Usually, in DC-DC converters every modelled topology is linear and thus the orbits can be computed taking advantage that analytical expressions of the solution are known in each topology. Thus, they are glued at the switching instants when the topology changes. It is well-known that sliding motions over the discontinuity surface can also exist.

A variable structure circuit, which is a first step in designing a DC-DC Buck converter under planar (constant) ramp voltage/current-mode control is used as an example exhibiting nonsmooth bifurcations. Fig. 1 shows the block diagram of the circuit. A constant control signal, is compared with the mixed voltage/current control.

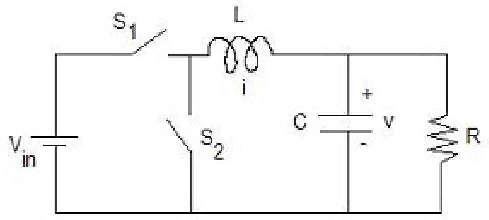


Fig.1 Scheme of the electronic circuit

In practical applications of this type of ON-OFF systems, an hysteresis band is provided to avoid the infinity frequency switching in case of sliding. For the sake of simplicity, this is not included in our model of the circuit. As it will be seen, nonsmooth behavior still occurs without an hysteresis band.

We have two linear topologies in continuous conduction mode. We will not consider discontinuous conduction mode in this paper, since we will assume that we have bidirectional switches, which allow negative currents.

If we fix a set of initial conditions, since the systems of differential equations are linear, we will be able to compute exactly the solution of each one. It follows that, between two commutation consecutive times, we know exactly the state variables of the system. Essentially, they are a combination of exponential and sinusoidal functions.

In each linear topology we can compute the equilibrium points and its stability. The stability can be checked computing the eigenvalues of the matrix in the differential equations. It is easy to check that the equilibrium points are spiral sinks. But we should not forget that the system switches the topologies depending on the switching condition and thus, in the nonlinear switched system it can happen that one, two or none of the equilibrium points are active.

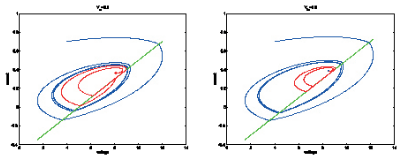
One of the equilibrium points is always at the origin, and the other moves as the input voltage is varied. The line corresponding to the switching condition is also plotted in the following figures, and some representative orbits are also shown.

2. Bifurcations

If the input voltage and the constant control signal are kept constant and Z is varied different bifurcations are obtained. First, there is an active equilibrium point. As Z is increased the two equilibrium points are both passive and there appears a new equilibrium point which belongs to the switching condition line. Also, orbits attracted by this point have a sliding phase. This bifurcation is a border collision one, since the switching condition line collides with one of the former equilibrium points.

Birth of a limit cycle in a non-smooth transition

For a certain parameter value, there is a birth of two limit cycles in a non-smooth saddle-node transition of limit cycles, where one is attracting and the other is repelling (see Fig. 2). They are nonsmooth since they have a part of the orbit in each smooth region.

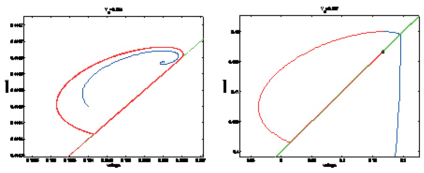


(a) (b)

Fig. 2. Phase portraits for two values of the input voltage. Blue: stable limit cycle; Red: unstable limit cycle.

We discuss with more detail the bifurcation sequence from the birth of limit cycles until its disappearance.

For an initial value of the input voltage, there exists only a stable focus. Later, a nonsmooth saddle-node bifurcation of cycles occurs, and a stable limit cycle and an unstable limit cycle are created, each one with a part in both smooth regions. The unstable limit cycle is inside the stable one, and the stable focus is inside the unstable cycle, which delimits its basin of attraction (see Fig. 2(a)). As the input voltage is continuously increased the amplitude of the unstable limit cycle gets smaller and smaller, (see Fig.2(b)) and finally it disappears in a border collision bifurcation (see Fig. 3), when the stable focus collides with the cycle. The stability of the focus changes and an unstable equilibrium point remains on the switching manifold as the input voltage is further increased.



(a) (b)

Fig. 3. (a) Coexistence of a stable focus (blue) and unstable cycle (red). (b) There is only a stable equilibrium point in the switching surface, and the limit cycle exists no more.

3.Conclusions

We discussed the occurrence of nonsmooth bifurcations leading to the formation of limit cycles in switching circuits and systems and appearance and disappearance of equilibrium points through border-collision bifurcations. A variable structure circuit was used to show their occurrence in Filippov systems. Many open challenges lie ahead. Current work is focussing on extending the analysis presented here to the case of three-dimensional and higher order systems.

A classification of all (or at least most) of nonsmooth transitions possible in nonsmooth systems must be attempted. We wish to emphasise that the onset of stable oscillatory motion, often coexisting with stable equilibria or other attractor, is highly undesirable in many applications.

Thus, giving conditions for the efficient detection of these event (which we recall are not associated to pair of complex eigenvalues crossing the imaginary axis as for smooth systems) is of utmost importance in applications.

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Software optimisation for the design, construction and testing of trawling techniques

1. Introduction

Technology in the fishing sector is advancing rapidly. Examples of these advances include new types of techniques and net control sensors**.** The Spanish fishing industry has lagged behind other European countries in as far as existing software able to calculate, design, draw and simulate trawling techniques(in three dimensions with movement), is concerned. The project **Software optimisation for the design, construction and testing of trawling techniques.** introduces software to cover these needs.

This SARTI project is financed by the National Program for Scientific and Technical Data Transfer (PETRI PTR1995-0735-OP), the participating organizations are UPC and CSIC (ICM). The main researcher is Francesc Sarda (ICM) and the collaborators are: Antoni Mànuel, Josefina Antonijuan, Joana Prat (UPC) y Olga Gualdo (CTVG), y Arnau Folch (CSIC)

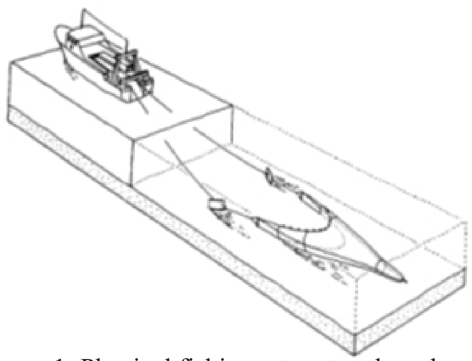

Figure 1: Physical fishing art system based on a ship, cable, doors and fishing net

2. Description

The objectives of this project are to:

- Find a mathematical model for the fishing arts physical system.
- Create a user-friendly graphical interface that simulates the system.
- Offer the product for pedagogical and industrial purposes.