Let us first consider the Chua's circuit, which in dimensionless form is describe by the equations:

$$\begin{aligned} \dot{x}_1 &= \alpha(-x_1 + x_2 + \phi(x_1)) \\ \dot{x}_2 &= x_1 - x_2 + x_3 \\ \dot{x}_3 &= -\lambda x_2 \end{aligned} \tag{1}$$

where the funtion $\phi(x)$ is given by:

$$\phi(x) = -\left( m_1 x + \frac{m_0 - m_1}{2} \left( |x+1| - |x-1| \right) \right)$$

and $\lambda$ is a contant which satisfies $23 < \lambda < 31$, $m_0 = -8/7$; $m_1 = -5/7$. This system is known to have so-called double scroll chaotic attractor (see [1]). We consider that the parameters $\{\alpha, \beta\}$ are not known.

Let us now take the output $y = x_1$, this system is obserbable with respect this output and hence it is constructible. Therefore, we can obtain an integral output parametrizations of the states $x_2$ and $x_3$ , modulo the unkown initial conditions. Indee from (1) we obtain the following structural estimates of the incremental states variables.

Integrating the equations (1) with respect to time and considering $y = x_1$, we clearly have

$$\begin{aligned} &\int x_2 = \tfrac{1}{\alpha}(y - y_0) + \int y - \int \phi(y); \\ &x_2 = \int y - \int x_2 + \int x_3 + x_{20}; \\ &x_3 = -\lambda \int x_2 + x_{30}; \end{aligned} \tag{2}$$

where the initials conditions are denotes by $\{y_0 = y(0), x_{20} = x_2(0), x_{30} = x_3(0)\}$ and

$$\int x = \int_0^\tau x(\tau_1) d\tau_1 \qquad \int\int x = \int_0^\tau \int_0^{\tau_2} x(\tau_1) d\tau_1 d\tau_2$$

Clearly, from the fisrt and the third equation in (2), we obain a integral parametrization of the state $x_3$, as a function of the output $y$, as follows:

$$x_3 = -\frac{\lambda}{\alpha}(y - y_0) - \lambda \int y + \lambda \int \phi(y) + x_{30} \tag{3}$$

Integrating again whit respect to time the above expression to obtain an estimated of the integral of the state $x_3$ and tacking an estimated of the integral of the state $x_2$ from the first equation of (2) and then substituting the obtained expression into the second equation in (2), we may obtain a integral parametrization of the state $x_2$, as a function of the output $y$, as:

$$\begin{aligned} x_2 = \int y - \tfrac{1}{\alpha}(y - y_0) - \int y + \int \phi(y) + \tfrac{\lambda}{\alpha}\left( \int y_1 - t y_0 \right) \\ + \lambda \int\int y - \int\int \phi(y) + t x_{30} + x_{20} \end{aligned} \tag{4}$$

Assuming that the output state $y$ is available and the function $\phi(y)$ is given a priory, then the states $x_2$ and $x_3$ may be computed, if the initial conditions $\{x_{30}, x_{20}\}$ and the parameters $\{\lambda, \alpha\}$ are known.

## 0.1 Identification

In this section, we briefly introduce a integral equation of the output that may be to compute the initials conditions $\{x_{30}, x_{20}\}$ and the parameters $\{\lambda, \alpha\}$, which are not known.

Integrating once again with repect to time the second equation and integrating twice again with respect to time in (2) and them combining the obtained equations, we get the following integral parametrization equation:

$$\int x_2 - \int\int y + \int\int x_2 - \lambda \int\int\int x_2 + \frac{1}{2} x_{30} t^2 + x_{20} t = 0.$$

From the first integral equation in (2), we may estimated from the first to third iterate integral of the state $x_2$ respectively. Thus after some algebraic manipulations, the above equation can be rewritten as follows:

$$\sum_{i=1}^{5} \lambda_i \Phi_i(t) = w(t)$$

where:

$$\begin{array}{ll} \Phi_1(t) = y_0 - y(t) + t y_0 - \int y; & \Phi_4(t) = t^2 \\ \Phi_2(t) = \iiint y + \iiint \phi(y); & \Phi_5(t) = t \\ \Phi_3(t) = \iint y + \frac{1}{2} y_0 t^2; & w(t) = \iint \phi(y) + \int (y + \phi(y)) \end{array}$$

and the constan parameters $\lambda_i$ are redefined as:

$$\lambda_1 = \tfrac{1}{\alpha} \quad \lambda_2 = \lambda \quad \lambda_3 = \lambda/\alpha \quad \lambda_4 = x_{30}/2 \quad \lambda_5 = x_{20}$$

**Remark 1** *Note that the funtion $\Phi_i(t)$ is a integral parametrization whit respect to the time $t$, which depend on the available output state $y$, modulu the known initial condition $y_0$ This auxiliary functions may be computed in line in any instant of time while the chaotic system (1), is developed.*

A.1) Suponiendo que podemos medir en cualquier intante de tiempo las variables: $\Phi_i(t)$ y $w(t)$ para i={1,2,..,5} entonces siempre existe una secuencias de tiempo $0 < t_1 < t_2 < .. < t_5$ tal que siguiente la matrix

$$\Phi(t_1, t_2, .., t_5) = \begin{bmatrix} \Phi_1(t_1) & & \Phi_5(t_1) \\ \Phi_1(t_2) & & \\ \vdots & & \\ \Phi_1(t_5) & & \Phi_5(t_5) \end{bmatrix} \tag{5}$$

es invertible. Por lo que el conjunto de parámetros $\lambda_i$ ,i=1,2,..,5 pueden ser determinados como sigue:

$$\begin{bmatrix} \lambda_1 \\ \vdots \\ \lambda_5 \end{bmatrix} = \Phi(t_1, t_2, .., t_5)^{-1} \begin{bmatrix} w(t_1) \\ \vdots \\ w(t_5) \end{bmatrix}$$

Comentario: Numericamente es posible calcular la inversa, lo que no he podido justificarlo bien es porque. Tengo mis dudas si es suficiente con aplicar el teorema de recontruccion Taken's Theorem. En realidad no soy matemático por esa razón es dificil para mi entender topologia.

Quisiera pedirel si usted puede ayudarme a justificar la ecuación (5),en realidad no soy matemático y es dificíl para mi entender la topología. Si usted me ayuda quizas podamos escribir un articulo referente a este tema.

La referncia del teorema: las puede ver en la pagina Web de

A) U. Parlitz http://www.physik3.gwdg.de/~ulli/

1996 An application of synchronized chaotic dynamics arrays, Phisic Letter A (1996)

(11996) How to Achive Synchronised Motio with a Finite Number of Samples.

B) Leon Chua Communication system via chaotic signals from a reconstruction viewpoint.

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