**S1 Text. Optimal control theory and control matrices**

Let us assume we have a generic dimensional dynamical system as:

**,** (S1.1)

If the drift term, , satisfies that i) (being the set of functions with continuous derivatives up to the order) and ii) , it can be re-written as the product of the state vector and a matrix that depends on the state itself, [1].

Taking equation (1) in the main document, two systems are constructed with identical parameters except for ( and ) and an external input entering the pathological system () for steering it towards the healthy state (). Equation (S1.1) is obtained from defining and using [2]. A convenient selection [1] of matrix for this system is:

**,** (S1.2)

where the system has also been augmented with a new equation for a stable state as a workaround solution to overcome the presence of state-independent terms [3]:

**,** (S1.3)

The symbol represents the th difference of the pathological and healthy solutions in the observable variables only, .

Now, under these transformations, (S1.1) has a (apparent) linear form and the linear quadratic control theory can be used to obtain the optimal control signal, [1,4]. In regulator problems, the system is required to maintain a steady state. A quadratic cost index is to be minimized in a time interval far bigger than the system’s time scales (infinite time):

**,** (S1.4)

The weight matrices and are chosen based on the speed of the responses and distance from the equilibrium point –the origin– that are sought to be achieved by the controller [5]. The second term in the integral associates with the energy used by the controller [6]. Additionally, observability is guaranteed if the matrix is positive definite. In this work, we chose and is a matrix of zeros except for the upper left submatrix, which is the identity matrix (according to the definitions in S3 Table, the values in and are expressed in and the cost, , in ). If the (augmented) system given by equations (S1.1)-(S1.3) is controllable and observable, there exists a local asymptotically stable solution to the optimal control problem [1,2]. The optimal state-feedback controller is obtained in the form:

,(S1.5)

where is the solution to the state-dependent Riccati equation (SDRE):

,(S1.6)

S1 Text. Supplementary references

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