

Within science and mathematics, dynamics is the study of how things change with respect to time, as opposed to describing things simply in terms of their static properties. The patterns we observe all around us in how the state of things change overtime is an alternative way through which we can describe the phenomena we see in our world. A state space also called phase space is a model used within dynamic systems to capture this change in a system's state overtime. A state space of a dynamical system is a two or possibly three-dimensional graph in which all possible states of a system are represented, with each possible state of the system corresponding to one unique point in the state space. Now we can model the change in a system's state in two ways, as continuous or discrete. Firstly as continuous where the time interval between our measurements is negligibly small making it appear as one long continuum and this is done through the language of calculus. Calculus and differential equations have formed a key part of the language of modern science since the days of Newton and Leibniz. Differential equations are great for few elements they give us lots of information but they also become very complicated very quickly. On the other hand we can measure time as discrete meaning there is a discernable time interval between each measurement and we use what are called iterative maps to do this. Iterative maps give us less information but are much simpler and better suited to dealing with very many entities, where feedback is important. Whereas differential equations are central to modern science iterative maps are central to the study of nonlinear systems and their dynamics as they allow us to take the output to the previous state of the system and feed it back into the next iteration, thus making them well designed to capture the feedback characteristic of nonlinear systems. The first type of motion we might encounter is simple transient motion, that is to say some system that gravitates towards a stable equilibrium and then stays there, such as putting a ball in a bowl it will roll around for a short period before it settles at the point of least potential gravity, its so called equilibrium and then will just stay there until perturbed by some external force. Next we might see periodic motion, for example the motion of the planets around the sun is periodic. This type of periodic motion is of course very predictable we can predict far out into the future and way back into the past when eclipses happen. In these systems small disturbances are often rectified and do not increase to alter the systems trajectory very much in the long run. The rising and receding motion of the tides or the change in traffic lights are also example of periodic motion. Whereas in our first type of motion the system simply moves towards its equilibrium point, in this second periodic motion it is more like it is cycling around some equilibrium. All dynamic systems require some input of energy to drive them, in physics they are referred to as dissipative systems as they are constantly dissipating the energy being inputted to the system in the form of motion or change. A system in this periodic motion is bound to its source of energy and its trajectory follows some periodic motion around it or towards and away from it. In our example of the planet's orbit, it is following a periodic motion because of the gravitational force the sun exerts on it, if it were not for this driving force, the motion would cease to exist.