Chaotic Dynamical Systems, SF2720

D-level, masters and graduate students

Since a couple of years chaotic dynamical systems is a field that has been quite noticeable in science. One aspect is chaos, fractals, etc., often illustrated with the fantastic pictures — the Mandelbrot set, Julia sets etc. — which arise from computer simulations of iterates of complex polynomials.

Another aspect is "Strange attractors", which arise from computer simulations of ordinary differential equations and difference equations. Some of the most famous mathematical experiments where done by the meteorologist E. Lorenz, who studied a simplified model for the Navier-Stokes equations and the astronomer M. H. Hénon, and here at this department we have studied this models rigorously and proved chaotic behaviour.

D. Ruelle and F. Takens have suggested that it should be possible to explain turbulent phenomena — at least partially by strange attractors.

A fundamental discovery in the area was done by the physicist M. Feigenbaum, who discovered how many systems go through a characteristic period doubling to later appear random (chaotic) in spite that the system is deterministic. Later it has been showed that these period doubling appear in liquid flows for liquid helium.

The course is from a mathematical point of view rather special. It gives on a fairly elementary level insight into phenomena, which are fairly close to the research front. We expect to carry through 1–2 computer exercises. The main aspect in the course is however the mathematical theory, which in fact has a long history with names such as Poincaé, Fatou, Birkhoff, Smale and others and which has during recent time has been developed quickly, partly in symbiosis with the computer experiments.

Time and place: The course will be given in English once a week during the fall with certain extra lectures, 36 hours in total. The first meeting is **Friday, September 5, 10.15–12.00, Seminar room 2733, Lindstedtsvägen 25, KTH**. The preliminary time for the rest of the lectures is Fridays, at the same time and place but I am open for other suggestions. The schedule will be discussed at the first meeting.

Literature: R.L. Devaney, *Introduction to Chaotic Dynamical Systems,* 2nd ed., Addison-Wesley. Other articles and relevent material will be handed out. An alternative book is Clark Robinsson *An introduction to dynamical systems: continuous and discrete* Pearson Prentice Hall, Upper Saddle River, NJ, 2004. xiv+652 pp. ISBN 0-13-143140-4.

If you cannot come to the first meeting, please contact me.

Very welcome!

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