

San Diego State University

Master of Science in Applied Mathematics with Concentration in **Dynamical Systems and Chaos**

<http://nlids.sdsu.edu/> [Graduate Programs]

1. Description

This exciting new graduate program is offered through the Nonlinear Dynamical Systems (NLDS) group. Dynamical Systems is an essential tool for the mathematical analysis of real life problems in fields that include: Physics, Engineering, Biology and Chemistry. The program provides analytical and computational tools/skills required to formulate and tackle complex models of real life problems. This MS is ideal in preparing students for recruitment in industry or government laboratories where a high level of mathematics and modeling is required.

An integral part of Dynamical Systems is the use of mathematical models and numerical techniques for which a strong knowledge of scientific computation is needed. Students in the Dynamical Systems program will acquire indispensable skills/tools in the use of computers for problem solving and hence increase their market value when seeking for a competitive employment opportunity.

Students enrolled in the program are mentored by faculty members actively engaged in research at the forefront of Dynamical Systems and Chaos, and its applications. Students in the program benefit from a dedicated Dynamical Systems state-of-the-art computer laboratory. Continuous interactions between the NLDS group and a large number of research groups/collaborators offers an ideal atmosphere for our graduate students to engage in scientific and industrial collaborations. For example the NLDS group has a strong link with the Space and Naval Warfare Systems Center (SPAWAR) in San Diego, including a couple of patents and student internships. The NLDS has also strong ties with the Physics and Computer Science departments at SDSU.

The NLDS group also offers a PhD program in Dynamical Systems and Applied Mathematics through the Computational Research Center (CSRC) at SDSU. Further information on the Ph.D. program can be found at: <http://nlids.sdsu.edu/> [Graduate Programs] [PhD]

2. Nonlinear Dynamical Systems (NLDS) group Faculty

Peter Blomgren - Numerical analysis, image processing, partial differential equations.

Ricardo Carretero - Applied mathematics, nonlinear lattices, nonlinear waves.

Joe Mahaffy - Mathematical biology, delay differential equations

Antonio Palacios - Applied mathematics, bifurcations, symmetries

Diana Verzi - Mathematical biology, Mathematical Physiology

[Ricardo Carretero](#) and [Antonio Palacios](#) serve as the program advisers:

Email: carreter@sciences.sdsu.edu or palacios@euler.sdsu.edu

Web: <http://nlids.sdsu.edu/> [Graduate Programs] [MS]

3. Admission Requirements

To be admitted to the program, students should have training equivalent to that required for an undergraduate degree in mathematics, applied mathematics, physics or electrical engineering. In addition, all students must satisfy the general requirements for admission to the university with classified graduate standing. The Department of Mathematics maintains a web page with further information on admission and financial support:

http://www.sci.sdsu.edu/math_stat/math_stat_grad.htm

4. Course Work

The following courses are required (3 units each):

- [MATH-531](#) Partial Differential Equations
- [MATH-537](#) Ordinary Differential Equations
- [MATH-538](#) Dynamical Systems & Chaos I
- [MATH-636](#) Mathematical Modeling
- [MATH-638](#) Dynamical Systems & Chaos II
- MATH-799A Thesis or Project



Fractal (Julia set): Black points correspond to initial conditions for $f(z) = z^2 + c$ ($c = 0.38 + 0.32i$) that do not diverge to infinity.

Recommended electives (3 units each): [These M696 special topics courses are offered depending on demand and resources.]

- [MATH-639 Nonlinear Waves](#)
- [MATH-635 Pattern Formation](#)
- MATH-693A/B Advanced Numerical Analysis
- Applied Bifurcation of Dynamical Systems
- Numerical Experiments and Methods in Dynamical Systems
- Nonlinear Time Series
- Fractal Geometry
- Mathematical Biology / Neural Modeling

Other recommended electives (3 units each): [Other courses, even in other departments, may be approved by adviser.]

- [MATH-541](#) Intro. to Num. Analysis and Computing
- [MATH-542](#) Intro. to Num. Solutions of Diff. Eqs.
- MATH-637 Theory of Ordinary Differential Eqs.
- MATH-668 Applied Fourier Analysis
- MATH-797 Research
- CS-553 Neural Networks
- PHYS-580 Computational Physics
- PHYS-585 Comp. Simulations in Physics
- PHYS-608 Classical Mechanics

5. Sample program

This sample program is intended to give an idea on the timing of different courses. Students enrolled in the Dynamical Systems program are required to complete a total of 30 credits (15 units of core courses + 12 units of electives + 3 units of Thesis/Project).

Year 1	Fall	MATH-537 Ordinary Differential Equations ¹ MATH-538 Dynamical Systems & Chaos I ¹ MATH-636 Mathematical Modeling ¹
	Spring	MATH-531 Partial Differential Equations ¹ MATH-638 Dynamical Systems & Chaos II ¹ MATH-693B Advanced Numerical Analysis
Year 2	Fall	MATH-635 Pattern Formation ² MATH-797 Research ³
	Spring	MATH-639 Nonlinear Waves ² MATH-799A Thesis or Project ³

¹ Core courses

² Special topics in Dynamical Systems. These courses are offered depending on demand and resources (typically one per year).

³ Research/thesis. Students work on a research project under close supervision of a member of the Dynamical Systems group.

6. Graduation Requirements

The graduate division requirements for a Master's degree are that a student complete 30 units of course work at the 500, 600 or 700 level. As noted above under Course Work, this program has a number of required courses. In addition, a master's thesis must be completed, which counts for 3 of the 30 units (MATH-799A).

The thesis is written under the direction of a faculty member who works closely with the student in both the research and the writing of the thesis. The student can choose any faculty member in the program to be the thesis adviser. The student and the adviser will determine the topic of the thesis, generally on a topic of interest to both. The average student takes about 6 months to complete a thesis.

7. Financial Aid

The Department of Mathematics offers teaching assistantships for the support of qualified students. Applications should include transcripts and two recommendation letters. There are a limited number of research assistantships available for students, but these are primarily for second year students working under a research grant with a NLDS group member. Application forms are available at the office of the Department of Mathematics or at: http://www.sci.sdsu.edu/math_stat/StudentAsstAppl.PDF

8. Contact Information

Further information on the *Concentration in Dynamical Systems and Chaos* and the *Nonlinear Dynamical Systems* (NLDS) group is available at:

<http://nlids.sdsu.edu/>

or contact:

[Ricardo Carretero \[carreter@math.sdsu.edu\]](mailto:carreter@math.sdsu.edu), or
[Antonio Palacios \[palacios@euler.sdsu.edu\]](mailto:palacios@euler.sdsu.edu)
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