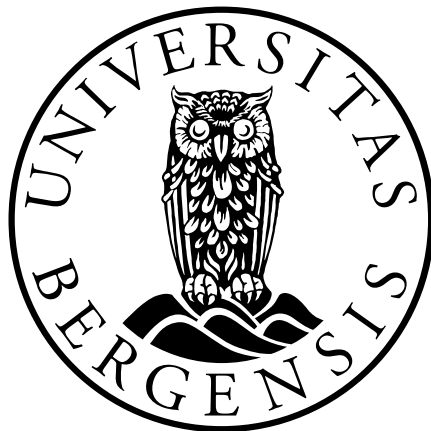


An International Course on Wave-Energy Extraction



John D. Carter

Visiting Professor
Mathematics Department
University of Bergen

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Professor
Mathematics Department
Seattle University

Seattle University



- ▶ Private, Jesuit university
- ▶ Located near downtown Seattle in Washington state
- ▶ 4.780 undergraduates & 2.000 graduate students
- ▶ Zero graduate students in science and engineering
- ▶ The university's foci are teaching and the student experience
- ▶ Mission Statement:

Seattle University is dedicated to educating the whole person, to professional formation, and to empowering leaders for a just and humane world.

About Me

- ▶ Ph.D. in Applied Mathematics from the University of Colorado at Boulder in 2001
- ▶ I study mathematical models of water waves, nonlinear PDEs, and numerical methods
- ▶ No real-world experience in wave-energy extraction. I am far from an expert on wave-energy extraction.
- ▶ Wave-energy extraction interests me
- ▶ I speak Spanish and have lived in Chile

Basic Course Info

- ▶ The course is taught every other year during the 10-week winter quarter
- ▶ We spend spring break (8 days) in Chile, mostly in Santiago at the Pontific Catholic University of Chile (“La Católica”), where we learn from Chilean wave/ocean experts
- ▶ It takes a minimum of 17 hours to get from Seattle to Santiago.
- ▶ 50 hours of class in Seattle
- ▶ 10-12 hours of class in Chile (plus culture)

Motivation for the Course

- ▶ Students are passionate about the environment
- ▶ Students are interested in renewable energy
- ▶ Students are interested in modeling
- ▶ Students want to study abroad
- ▶ Students want to take challenging courses

This course is guided by these motivations.

Course Requirements

- ▶ Sophomore-level differential equations
- ▶ First-year physics
- ▶ Strong academic standing
- ▶ The trip to Chile is required

Who Takes the Class?

- ▶ Mostly juniors and seniors
- ▶ Mathematics, Mechanical Engineering, Electrical Engineering, and Computer Science students
- ▶ Typically very strong students
- ▶ Roughly 40% female
- ▶ The class has had 9, 15, and 12 students

Scientific Learning Outcomes

Upon successful completion of the course, students will be able to:

- ▶ Describe fluid properties, equations, and boundary conditions
- ▶ Describe and give physical descriptions of some major mathematical wave theories
- ▶ Compare and contrast standard models for water waves
- ▶ Derive and solve some simplified wave models
- ▶ Describe how waves evolve as they approach a coastline
- ▶ Describe how major wave-energy extraction devices function
- ▶ Describe how to select/optimize a device based on given wave data
- ▶ Describe state-of-the art tidal and wave-energy extraction devices

Cultural Learning Outcomes

Upon successful completion of the course, students will have:

- ▶ Learned Chilean history, geography, government, etc.
- ▶ Learned from Chilean experts
- ▶ Visited Chilean wave laboratories
- ▶ Interacted with Chilean students and faculty
- ▶ Experienced first-hand Chilean culture, food, and drink
- ▶ Visited Chilean museums, restaurants, parks

Course Funding

The course is expensive.

- ▶ The Dean pays for me to teach the class
- ▶ The Dean pays all of my Chilean expenses
- ▶ The Dean pays for an invited speaker
- ▶ The Dean provides some student scholarships
- ▶ Students pay for their own airfare (~8.500 NOK)
- ▶ Students pay a \$1.250 (~10.500 NOK) course fee

Course Material in Seattle

- ▶ Introduction to PDEs
- ▶ Dispersion and dispersion relationships
- ▶ Fourier series and spectra
- ▶ Fourier methods
- ▶ Euler equations
- ▶ Wave energy
- ▶ Asymptotic approximations to the Euler equations (NLS, KdV, etc.)
- ▶ Real-world considerations
- ▶ Ocean-wave spectra
- ▶ Wave-energy extraction devices
- ▶ Wave shoaling

Course Material in Chile

- ▶ State-of-the-art wave-energy technology
- ▶ Tidal-energy extraction project
- ▶ Tsunamis and natural disasters

Typical Course Schedule

- ▶ **January 6-March 23:** Standard course (5 hours per week)
- ▶ **March 24:** Travel to Santiago
- ▶ **March 25 (Sunday):** Arrive in Santiago early morning, get settled, tour city
- ▶ **March 26:** Tour campus, science taught by Dr. Cienfuegos, visit Cerro San Cristobal
- ▶ **March 27:** Science taught by Dr. Cienfuegos, visit the Museum of Human Rights
- ▶ **March 28:** Day trip to Viña del Mar, Casa de Pablo Neruda
- ▶ **March 29:** Science taught by Dr. Catalan, visit Santa Lucia
- ▶ **March 30:** Science taught by Dr. Escauriaza, explore Santiago
- ▶ **March 31:** Explore the Maipo canyon and hike in the Andes. Depart for Seattle at night
- ▶ **April 1 (Sunday):** Travel to Seattle

Any Questions?



My email: carterj1@seattleu.edu