Chao Ni

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EDUCATION

Peking University, Beijing, China
Bachelor of Science
In Theoretical and Applied Mechanics
College of Engineering, 2015-Present — Major GPA: 3.70/4

Johns Hopkins University, Baltimore, American
Visiting Student, Advised by Gregory Chirikjian
The Laboratory for Computational Sensing and Robotics

SELECTED COURSES

Calculus (I)	3.85/4	Probability and Mathematical Statistics	3.91/4
Calculus (II)	3.73/4	Fluid Mechanics	3.81/4
Data Structure and Algorithm (H)	3.66/4	Engineering information retrieval & Scientific Writing	3.95/4
Theoretical Mechanics	3.77/4	Computational Fluid Dynamics	3.63/4
Ordinary Differential Equations	3.93/4	Finite Element Methods	3.93/4
Electromagnetism	3.88/4	Entrepreneurship: New Venture Creation	3.85/4
Mechanics of Materials	3.68/4	Modern Physics	3.75/4
Advanced Dynamics	3.88/4		
Numerical Analysis	3.58/4		
Methods of Mathematical Physics	3.88/4		

PUBLICATION

- **Chao Ni**, Geng Chen, Qining Wang, "Assistive Torque Design for Hip-joint Exoskeleton by Admittance Shaping using Loop Shaping Method", in submission.

RESEARCH EXPERIENCE

Assistive Control of Lower Exoskeleton
Advisor: Qining Wang **Collaborator:** Geng Chen — 2017.7-Present

- Used loop shaping method to raise the natural walking frequency of human lower limb, thus making the patient have better walking performance.
- Put forward a double-pendulum-based model to simulate the dynamics of the lower-limb and deduced the transfer function considering the impedance control.
- Introduced a DC gain feedback controller and a lead controller to shift the frequency curve upwards and rightwards. Our journal paper is in submission.

Action Recognition
Advisor: Gregory Chirikjian **Collaborator:** Sipu Ruan — 2018.6-Present

- Utilized gradient descent method and its variant RMSprop to compute the temporal reparameterization mapping function.
- Simulated the temporal fluctuation effect, illustrated the difference between a uniformly distributed video and video with temporal fluctuation. The video can be found at https://nichao.xyz/research.html.
- Utilized global optimal reparameterization algorithm (GORA) as a preprocess for frame selection in deep learning architecture.
- Compared the training performance between GORA based frame selection method, uniform selection and random selection. Verified the advantage of GORA based frame selection preprocess.

Model Predictive Learning Control in Rehabilitation
Advisor: Qining Wang — 2018.3-Present

- Proposed to realize self-adaptation feature of Assistive Exoskeleton in long distance walking because of the uncertainties in real human walking process.

- Combined the model predictive control and iterative learning control into the same framework, the uncertainty error would vanish after several walking gaits.
- Developed the model predictive learning control framework, operated on YALMIP with MATLAB platform, verified the control rule by simulation. It showed after certain number of swing iterations, the assistive performance would become better and steady. We expect to apply this rule on real exoskeletons to verify its performance.

COURSE PROJECT

Fortran Writing for Finite Element Analysis
Advisor: Pu Chen 2018.3-2018.6

- Rewrote the "Beam" Fortran code and took sheering, rigid zone and partially rigid connection into consideration.
- Simulation result showed the updated code do better in real engineering building. The simulation-experiment error decreased dramatically after code improvement.
- Gave a talk and made a presentation for this project, the report can be found at https://nichao.xyz/research/FEM.pdf.

Incompressible Flow in a Unit Square
Advisor: Qingdong Cai 2018.3-2018.6

- Utilized method of Successive over-relaxation to solve the Poisson equation, found the relaxation parameter 1.945.
- Solved for the streamline graph under different Reynolds numbers, observed the phenomenon of turbulence and compared several differential schemes.
- The simulation video can be found at https://nichao.xyz/research/streamline.avi.

SKILLS

Programming: C/C++, Python, MATLAB, Fortran, LaTeX
Control Methods: MPC, ILC, Loopshaping
Deep Learning: TensorFlow, Pytorch, Linux
Statistics: R, STATA, SPSS

AWARDS

- Chen Overseas Exchange Scholarship (1%)
- National Talent Scholarship (1%)
- Xia & Huan Undergraduate Internship Scholarship (10%)
- 2017 Academic Excellence Awards (5%)
- First Prize for the Mathematical Modeling Contest held in PKU (Top 1 among 32 teams)
- Second Prize for the National Physics Olympic Competition (10%)

ACTIVITIES

Globex Program of College of Engineering
Advisor: Daricha Sutivong 2016.7-2016.8
Teaching Assistant

- Received and registered the students in the course from all over the world
- Invigilated the exam and revised the projects submitted by students