Chen-Zhu Xie 谢尘竹

Portfolio: [github] [youtube] [linkedin]
Scholar: Γ Γ
Preference:
Contact: ✉ X
Personality: aries INTP ab

EDUCATION

Nanjing University   **College** of Engineering and Applied Sciences   **Nanjing, Jiangsu**

Doctor of Philosophy	*Optical Engineering*	*Q.E. – Top 15%* ▶	Nonlinear Fourier Optics ○	– 2025.06

Dissertation: "Analytic 3D vector linear non-uniform & nonlinear Fourier crystal optics in arbitrary $\bar{\bar{\varepsilon}}, \bar{\bar{\chi}}$ dielectrics" ○

Master 's Studies	*Quantum Electronics*	*Courses Score – 93.5* ○	THz OAM Source ○	– 2022.06

Northeastern University   **School** of Physics, **College** of Science   **Shenyang, Liaoning**

Bachelor of Science	*Applied Physics*	*GPA Rank – 1/400* ○	DDTank Aimbots ▶	– 2020.06

Thesis: "Research & design of nonlinear holography based on lithium niobate 3D nonlinear photonic crystal" ▶ ○

Freshman in College	*Science*	*Sichuan Prov. – Top 2%*	3 e-books with C++ ○	2016.09 –

PERSONAL PROJECTS

Behind NLAST   **Some techniques deployed in my acedemic project - NLAST**   2023.05 –

- Managed to realize tree-print feature in CMD lines without knowing *any tree*-packages
  - � in order to visualize run-time *Call Stack* with *buried checkpoints* & display *crucial info*
  - to understand the *hierarchical structure* of my code from a more *abstract* perspective
- Enable *multi-threads* to accelerate *for loops* in python while preserving the *loops*' order
  - Implemented thorough utilizing the *producer-consumer model* (producer = thread pool)
  - Allow users to select which parts of the codes in the *for loops* to *parallelize* in CPU
  - Future model will move away from Python as the primary language & shift to GPU
    - Favoring GPU is driven by "*fields* in Physics = *arrays*/*matrices* in Math/Programs"
- Developed a log file system to track & record the operating status for debugging
  - to output script parameters (`**kwargs`) for rapid reproducibility of data in the future
  - to store data files & folders, and their metadata for swift data import and reutilization   [repo]

DDTank Aimbots   **Analytic solution** $E(r)$ to $\left[(\nabla\times)^2 - k_0^2 \bar{\bar{\varepsilon}} \cdot \right] E(r) = 0$ **where** $\varepsilon_{ij} \in \mathbb{C}$ 2023.02 –

- Drawing insights from PRS.A. #M.V.Berry's legacy | A.O.P. | A.P.B. | J.QSRT.
- The next generation of this project will come really close to the exact solution
- logging system
  - ○ J.O.S.A. #Bloembergen's legacy1 | J.O. | O.M. | O.M. | J.O. | L.P.R.
  - ○ JOSA.A. | O.E. #tightly focus #$\bar{\bar{\varepsilon}}$ anisotropy | Light.Sci.App. | O.E.   PPT 1 2 3 ... ○

Three Books **Closed-form** $E_3(\boldsymbol{r})$ in $\left[\boldsymbol{\nabla}^2 + k_3^2\right]E_3(\boldsymbol{r}) = -k_{03}^2\,\chi(\boldsymbol{r})E_1(\boldsymbol{r})E_2(\boldsymbol{r})$ 2022.02 –

- Solving this multivariable/field nonlinear convolution equation on my own
- Strong alternative to Green's Function, pseudo-spectral, split-step Fourier methods
- Developed a log file system to record and output script runtime parameters**kwargs,
  - P.R.L. #Green | P.R.L. #experiment #quantum | P.R.L. #experiment #scatter | P.R.L.
  - L.P.R. #SSF #quantum | Matlab #RCWA | A.P.L. #femtosecond pump
  - O.L. | P.R.A. PPT 1 2 3 4 … ◯

Scientific Activities

[0] **The 4th Nanjing University Doctoral Interdisciplinary Innovation Forum** **Nanjing, Jiangsu**
"Analytic vector linear & nonlinear Fourier crystal optics in arbitrary $\bar{\bar{\varepsilon}}, \bar{\bar{\chi}}$ dielectrics" | Oral [PPT] 2024.05.29

[-1] **2023 CSOE-NJU[1] Book Club Meeting & Sharing Session** **Nanjing, Jiangsu**
"A guided tour to Ray & Wave Optics Simulation" | Oral [PPT] 2023.12.09

[-2] **Academic Café Salon of the Research Group** **Nanjing, Jiangsu**
"Bi-directional notes on Nonlinear Optics in a roam-like app: RoamEdit" | Oral [PDF] 2021.05.21

Publications

[0] P. Chen, X. Xu, T. Wang, C. Zhou, D. Wei, J. Ma, J. Guo, X. Cui, X. Cheng, **C. Xie**, S. Zhang, S. Zhu, M. Xiao, and Y. Zhang, *Laser nanoprinting of 3D nonlinear holograms beyond 25000 pixels-per-inch for inter-wavelength-band information processing*, Nature Communications **14**, 5523 (2023)

[-1] J. Guo, Y. Zhang, H. Ye, L. Wang, P. Chen, D. Mao, **C. Xie**, Z. Chen, X. Wu, M. Xiao, and Y. Zhang, *Spatially Structured-Mode Multiplexing Holography for High-Capacity Security Encryption*, ACS Photonics **10**, 757–763 (2023)

Academic Focus

Next generation high N.A. 3D vector non-uniform analytic linear & nonlinear Fourier crystal optics ◯		2024.06 –
!Paraxial k_0^ω **High N.A.** 3D vector non-uniform analytic linear & nonlinear Fourier crystal optics ◯		2024.03 –
Emphasizing G_{xyz}^ω **3D** vector non-uniform analytic linear & nonlinear Fourier crystal optics ◯		2023.12 –
Involving $\bar{\bar{\chi}}_\omega^{(2)}$ anisotropy **Vector** non-uniform analytic linear & nonlinear Fourier crystal optics ◯		2023.06 –
!Unitary $G_\omega^\pm \Leftarrow$!Hermitian $\bar{\bar{\varepsilon}}_{\mathrm{r}}^\omega \Rightarrow$ **Non-uniform** analytic linear & nonlinear Fourier crystal optics ◯		2023.03 –
Solution $\boldsymbol{E}_\omega^\pm$ to $\left(\boldsymbol{\nabla}^2 + k_{\omega\pm}^2\right)\boldsymbol{E}_\omega^\pm \propto \boldsymbol{P}_{\omega\pm}^{(2)}$ **Analytic** linear & nonlinear Fourier crystal optics ◯		2022.09 –
Solution $\mathcal{F}[E_3] = \mathcal{F}\left[f\left(\mathcal{F}^{-1}[\cdot]\right)\right]$ to the Eq. below **Nonlinear** angular spectrum theory for SFG ◯		2022.06 –
Solution $\mathcal{F}[E_3] = \iiint$ to $\left(\boldsymbol{\nabla}^2 + k_3^2\right)E_3(\boldsymbol{r}) \propto P_3^{(2)}(\boldsymbol{r})$ **Nonlinear** convolution solution to SFG ◯		2022.03 –
◯ Nonlinear THz LiNbO$_3$-based metasurface **Quit THz project formally**	COMSOL	– 2022.01
◯ BWOPO + THz optical parametric amplification Mathematica	BookxNote Pro	– 2021.12
◯ THz backward optical parametric oscillator (BWOPO) Mathematica	VBA Excel	– 2021.11
◯ Multi-cycle THz orbital angular momentum (OAM) source RoamEdit	Blender	– 2021.11

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[1] The Nanjing University student branch of the Chinese Society for Optical Engineering

- Narrow-band THz OAM source via Optical Rectification (OR) — Python | Blender – 2021.10
- Electricity $\xrightarrow{\text{produce}}$ Acoustics $\xrightarrow{\text{modulate}}$ Optics — RoamEdit | VBA Excel – 2021.07
- Visible Photons $\xrightarrow{\text{SPDC}}$ THz Spectroscopy — BookxNote Pro | GeoGebra | VBA Excel – 2021.06
- Cavity Phase Matching $=$ Sheet OPO — Paint 3D | RoamEdit | GeoGebra | VBA Excel – 2021.05
- THz Holography via Optical Rectification — Matlab | GeoGebra | VBA Excel – 2021.01
- Femtosecond laser $\xrightarrow{\text{Optical Rectification}}$ Terahertz (THz) — GeoGebra | VBA Excel – 2020.12
- Multicycle THz pulse generation by OR in $LiNbO_3$ ... crystals — VBA PowerPoinT – 2020.10

Honors & Awards

Category					
Academia	Doctor's Qualification Exam (Oral) ▶	Excellent ⊕	*Top 15%*	Nanjing U.	2024.01
	Bachelar Thesis ⊙ & Defense ▶	Excellent ⊙	*1/90*	Northeastern U.	2020.06
Competition	Three Provinces Achievement Expo ⊕	Exhibition ⊙	*Leader*	Three Prov.	2019.10
	"Challenge Cup" Tech Competition ⊕	Grand prize ⊙	*Leader*	Liaoning Prov.	2019.06
Scholarships & Fellowships	Academic Fellowship	1st class	*¥40,000*	Nanjing U.	2020-24
	"Jinchuan" Scholarship	1st place ⊙	*¥5,000*	Northeastern U.	2019.04
	Academic Scholarship	1st place ⊙	*¥2,000*	Northeastern U.	2018.06
	Entrance Scholarship	3rd place	*¥5,000*	Leshan No.1 H.S.	2013.09
Honors & Titles	Graduation with Honor ⊕	Outstanding		Northeastern U.	2020.07
	League Member ⊕	Excellent ⊙		Northeastern U.	2019.11
	Undergraduate Student	Excellent ⊙		Northeastern U.	2018.12
Memberships	Chinese Society for Optical Engineering	Member ⊙		Nanjing U.	2021-25
	"Qian Sanqiang" Talent Class	Head ⊕		I.H.E.P. ⊕	2017-20

Research Projects

3D Vector Nonlinear Fourier Crystal Optics	**Solving** $\left[(\boldsymbol{\nabla}\times)^2 - k_0^2\, \bar{\bar{\varepsilon}}\, \cdot \right] \boldsymbol{E}(\boldsymbol{r}) = k_0^2\, \bar{\bar{\chi}} : \mathcal{F}_\omega^{-1}\left[\widetilde{E}_{\mathrm{p}} \widetilde{E}_{\mathrm{p}} \right](\boldsymbol{r})$ **analytically**	2023.05 –

- The first & fastest white box solver ever for this inhomogeneous wave equation
  - or other similar equations, with unprecedented efficiency-accuracy product
- No competitors for the time being: other methods or software including
  - k-space RK4, pseudo-spectral, SSF, Green's Function methods, FDTD, COMSOL...
- Reproduced well-known papers, all of which provide either zero or wrong theory:
  - Nat.Photo. #proven theoratically wrong by this project #femtosecond pump
  - O.E. #Bloembergen's legacy2 #experiment | O.M.E. #z-component
  - O.E. | Q.E. #high N.A. #$\bar{\bar{\chi}}$ anisotropy — PPT 1 2 3 ... ⊙

Complex Vector Linear
Fourier Crystal Optics

Analytic solution $E(r)$ to $\left[(\nabla\times)^2 - k_0^2\,\bar{\bar{\varepsilon}}\cdot\right]E(r) = 0$ where $\varepsilon_{ij} \in \mathbb{C}$ 2023.02 –

- Drawing insights from PRS.A. #M.V.Berry's legacy | A.O.P. | A.P.B. | J.QSRT.
- The next generation of this project will come really close to the exact solution
- Reproduced well-known papers, some are purely experimental (too hard to model):
  - J.O.S.A. #Bloembergen's legacy1 | J.O. | O.M. | O.M. | J.O. | L.P.R.
  - JOSA.A. | O.E. #tightly focus #$\bar{\bar{\varepsilon}}$ anisotropy | Light.Sci.App. | O.E.   PPT $\underline{1}\,\underline{2}\,\underline{3}$ ... ⬤

Real Scalar Nonlinear
Fourier Crystal Optics

Closed-form $E_3(r)$ in $\left[\nabla^2 + k_3^2\right]E_3(r) = -k_{03}^2\,\chi(r)E_1(r)E_2(r)$ 2022.02 –

- Solving this multivariable/field nonlinear convolution equation on my own
- Strong alternative to Green's Function, pseudo-spectral, split-step Fourier methods
- Reproduced well-known papers & models with maximum accuracy & efficiency:
  - P.R.L. #Green | P.R.L. #experiment #quantum | P.R.L. #experiment #scatter | P.R.L.
  - L.P.R. #SSF #quantum | Matlab #RCWA | A.P.L. #femtosecond pump
  - O.L. | P.R.A.   PPT $\underline{1}\,\underline{2}\,\underline{3}\,\underline{4}$ ... ⬤

EXTRACURRICULAR ACTIVITIES

- Member at Some Club   2017–Current
  Detailed explanation of what you do at this club

- Member at Some Club   2016–2017
  Detailed explanation of what you do at this club

- Volunteer at Some Event   Fall 2019
  Detailed explanation of what you do in this event

- Volunteer at Some Event   Winter 2015
  Detailed explanation of what you do in this event

SKILLS

- **Skill Group:** List of technologies
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LANGUAGES

- **Language:** language proficiency level
- **EXAM:** details
- **Language:** language proficiency level
- **Language:** language proficiency level