

China's Space Forces:

Research by Key Faculty at the PLA's Space University

Summary

A recruiting video posted by the PLA Space University highlighted 11 named academics as key faculty for the 2020 school year. A review of the research work by these 11, as documented in their academic journal articles and patent awards, showed a full range post-doctoral level research on space technology topics. The majority of the work thus documented can be grouped into the following areas of emphasis:

- **Optical Imagery Technology:** multi-satellite imaging planning, opto-electronic information processing, and image fusion methods.
- **Laser Imaging Technology:** laser absorption spectroscopy, LIDAR receiver characteristics, and resolution of laser radar.
- **Satellite Data Transmission:** antenna technology for space information transmission, signal processing, and satellite network topology.
- **Satellite Communications:** secure satellite transmission, space laser communications, and communications management systems.
- **Launch Vehicle Technology:** propulsion engineering and especially liquid booster engine combustion mechanisms.
- **Space Object Detection:** laser technology in space object detection and ground-based photoelectric detection.
- **Space Support To Combat:** satellite imagery intelligence in combat operations, support to air precision strike operations, and exo-atmospheric target interception.
- **Artificial Intelligence Processes:** imaging satellite automatic detection methods and automatic space object identification based on machine learning algorithms.

The work done by the PLA's Space University almost certainly responds to national-level direction. Thus, the distillation of faculty research shown above suggests the primary technological building blocks that China intends to use to achieve dominance in space.

"Space" symbol from Space University logo



Source: sohu.com

Background

China's Space University (full name: Peoples Liberation Army Space Engineering University) advertises annually for student applicants to take training at this school and become officers in China's Space Systems Department, their equivalent of the U.S. Space Force. Graduate and doctoral programs are also advertised. One such solicitation for doctoral candidate students for the 2020 school year was posted with a video introducing Space University. This five-minute video gave an overview of the school, including short clips of 11 named faculty members including the school's president, Maj Gen Zhou Zhixin.

Since these were in essence the “stars” of this short film, it was presumed that their work was considered exemplary by the university. An examination of the backgrounds of these 11 faculty members showed that they were in fact well-known academics, often serving at this university for years, and were key contributors in terms of research work as well as teaching classes. Some have individually published more than 200 academic journal articles about their research. Many also have an extensive set of patents awarded for their research work.

A review of the papers and patents by the sample set of these 11 was conducted to gain insight into the nature of space technology research at this institution. Since this school was only restructured as Space University in 2017, much of the work was done while these professors were conducting space-related research in its predecessor, the PLA Equipment Academy. The results of this review—the documentation of the academic background of each, their research papers, and their patents—are shown below. Faculty members are listed below in the order of their appearance in the video.

Key Faculty

Zhou Zhixin

History: Maj Gen Zhou Zhixin (周志鑫) has been the President of Space University since its creation in 2017. He was born in Anhui Province in 1965. He entered the PLA in 1982 and received his bachelor's degree from the PLA Electrical Engineering College in 1986. He went from there to the Harbin Institute of Technology (HIT) and received his master's degree there in 1989. He was assigned as an engineer at the Air Forces No. 1 Flight School Simulation Center until 1993, when he returned to HIT and was awarded his

Space University President
Maj Gen Zhou Zhixin



Source: sohu.com

doctorate in 1997. He performed post-doctoral research work at the China Academy of Sciences' Automation Institute from 1997 to 1999. After this assignment, he conducted research at the Beijing Remote Sensing Information Research Institute. According to Chinese sources, Zhou Zhixin later served as Director of the former Second Department Technical Bureau, which was also known as the Space Reconnaissance Bureau. Sometime later, biographies state he "served as director of a certain (unnamed) agency in the PLA's Strategic Support Force."

He is primarily identified as a space remote sensing applications expert. Chinese biographic data state that his work history includes technical research in space remote sensing theory and applications; land feature characteristics sensing and recognition; automatic detection methods for sensing multiple seaborne targets; and space remote sensing data storage, processing, and application infrastructure.

Papers: Only three papers by Zhou Zhixin were found online, all from his time at Harbin Institute of Technology in 1997.

Patents: He has, however, registered more than 40 patents related to space-based remote sensing and satellite development. His most recent patents include:

- Unfolding System For Optical Imaging Satellite Bottom Light Shield (2019)
- Conformal Structure For An Optical Imaging Satellite (2019)
- Object Variations Monitoring Method For Multi-Source Multi-Temporal Remote Sensing Images (2016)
- Multi-Source Remote Sensing Image Fusion Method Based On Deep Learning (2016)
- Remote Sensing Target Recognition Methods (2016)
- Detection Method In Large-Scale Time Series Remote Sensing Imagery Changes (2015)
- In-Orbit Compression Method For High Spectrum Images (2014)
- Salient Objects Change Detection Method For Remote Sensing Images (2013)

Zheng Huaizhou

History: Maj Gen Zheng Huaizhou (郑怀洲) is currently Deputy Director of Space University. He was previously associated with the school when it was called the PLA Equipment Academy. His expertise is described as being in military studies, weapons industry, and military technology.

Papers: Gen Zheng's written work suggests that he was included in the promotional video based on his leadership position in the university rather than his academic experience in the space domain. His papers deal mostly with equipment development strategy and training issues. The limited work found included the following titles:

- Evolutionary Game Of Coordinative Innovation Of Equipment Development (2015)
- Research On The Design And Reconstruction Of Equipment And Material Supply Chain Under Informationized Conditions (2014)
- Research On The Strategy Of Equipment Development Collaborative Innovation (2015)
- Equipment Personnel Joint Education-Joint Training Development Method Summary (2013)
- Research On Core Capabilities Development For Equipment Safeguards In Strengthening Systems Combat Conditions (2013)

Zheng Huaizhou



Source: sohu.com

Zhao Hongli

History: Maj Gen Zhao Hongli (赵洪利) is also a Deputy Director of Space University. Online sources provided little information about his academic background other than that he is a professor, he served as Equipment Academy Training Department Director in 2014, and was in the Space University Graduate Student College as of 2018. He is credited with expertise in military studies, automation technology, and the instrumentation and measurement industry. He is a China Electronics Society senior member and a Beijing Communications Society member.

Papers: Zhao Hongli's academic papers show expertise in satellite network topology, integration of satellite imagery intelligence into combat operations, and use of AI technology in automated combat. His most recent published works include the following:

- Multi-Agent Decision Making Using Monte Carlo Q-Value Function (2020)
- Dual Network Intelligent Decision Method For Autonomous Fighter Combat Maneuvers (2019)

Zhao Hongli



Source: sohu.com

- Survey Of Battlefield Target Aggregation Behavior Recognition Methods For Information Imagery (2019)
- Research On Operational Views Of Air Precision Strike Operations With Space Information Support Based On DoDAF-OODA (2019)
- Evaluation Of Satellite Equipment's Contribution To System War Fighting (2019)
- Research On Military Forces Online Education Model And Study Support Services (2018)

Wang Yuanqin

History: Sr Col Wang Yuanqin (王元钦) may have been educated at the Harbin Institute of Technology (HIT) as he is credited in several papers as working at HIT's Institute of Ultra-Precision Optical & Electronic Instrument Engineering. His written works associated with HIT cover a range of topics including Doppler radar, FM radar, airborne radar, radar cross-section, electromagnetic wave scattering, and echo suppression. Space University documents show that he was teaching in the PLA Equipment Academy's graduate Information and Communications Engineering program in 2014, specifically in a course for Flight Vehicle Testing and Control. He stayed on as part of the Electro-Optical Engineering Department when the school was converted to Space University. Journal article credits for 2020 identify him as also working in the university's State Key Lab for Laser Advancement and Its Applications.



Source: sohu.com

Papers: His expertise in radar technology is reflected in earlier papers, such as:

- Model And Method Used For Extraction Of Projectile Motion Information From Radar Echo (2010)
- On Separating The Information Of Slow-Mode Angular Motion Of Projectiles (2010)
- Radar Echo Envelope Extraction Using Teager Energy Operator And Wavelet Transform (2008)

Later works highlight research in satellite signals processing:

- Summary Of Multiple Antenna Technology For Space Information Transmission (2020)
- Platform For Space Measurement And Control Signal Processing In A Cloud Environment (2018)

- High-Speed QPSK Parallel Demodulation Method Based On Data Decomposition (2018)
- Aerospace TT&C Signal Processing Platform On Cloud Computing (2018)
- An IMM-EKF Based Frequency Estimation Algorithm For High Dynamic Beidou Navigation System Signal (2017)

Patents: Wang Yuanqin also holds a number of patents related to laser devices, including:

- Vortex Rotation Shaping And Multi-Singularity Control Method Based On High-Order Cross Phase (2020)
- System Loss Parameter Detection Device Of Exciton Polarization Excimer Carrier (2019)
- Matrix Spiral Phase Plate Based On Cascade Vortex Light Preparation Method (2018)

Wu Lingda

History: Prof. Wu Lingda (吴玲达) was born in 1962. One biographic sketch said that she entered the PLA National University of Defense Technology (NUDT) in 1978, where she received her bachelor's, master's, and doctoral degrees. While working as a researcher at NUDT's Information Systems and Management College, her work involved image recognition equipment, computer simulation equipment, and satellite communications. In 2010 she entered the PLA Equipment Academy and has been engaged in research and education work in multimedia technology. As of 2011 she was listed as an Equipment Academy Key Lab professor. After 2011 she also served as the Director of the Multimedia Technology Special Committee. By 2014 she was teaching at the Equipment Academy graduate Information Systems Technology and Applications program. As of 2018 she was identified as working in the Space University Complex Electronic Systems Simulation Laboratory. She has also held positions outside the university as a General Equipment Department National Defense Systems Analysis and Systems Experts Group member and an All-Army Information Network and Information Security Coordination Group expert.



Source: sohu.com

Papers: Wu Lingda has written more than 200 papers during her academic career, documenting her expertise in satellite communications and optical imagery. Her most recent written work includes:

- Method And System For Weapons Equipment Systems Effectiveness Evaluation Based On An Algorithm (2020)
- Unsupervised Hyperspectral Unmixing Based On Robust Non-Negative Matrix Factorization (2020)
- Integration Of Space-Light Spectrum And Images (2019)
- Fusion Of Multispectral And Panchromatic Images Via Morphological Filter (2019)
- Space Information Network Topological Structure Modeling Method Based On Multi-Level Network (2019)
- Image Fusion Method Using Multi-Scale Analysis (2019)
- Dual-Polarized Satellite Security Transmission Scheme Based On Double Layer Multi-Parameter Weighted-Type Fractional Fourier Transform (2019)

Patents: She was also granted a series of patents over the past ten years dealing mostly with image processing, including:

- System-Level Package-Management-Based Signature Authentication Method And Server (2018)
- Flow-Field Visualized View Quantization Method Based On Effective Information (2017)
- Feature Line Extracting Method Combining Water Simulation And Double TPI Parametric Methods (2017)
- Underwater Scene Three-Dimensional Point Cloud Reconstruction Method And System Based On Vision (2017)
- Software Distribution Security Guard Method (2017)
- One-Dimensional Eight-Point IDCT Parallelism Method For Feiteng Processor (2014)

Feng Shuxing

History: Sr Col Feng Shuxing (冯书兴) joined the PLA Equipment Academy in 1994. His expertise in space vehicles is suggested by his co-authoring a book published in 1995 entitled “Guidance, Control And Simulation Of Manned Spacecraft In Reentry Phase.” Starting in 1996 he worked in inspection and certification for the Academy’s Military Space Research Center, Space Testing and Training Center, and key labs. He was also reportedly involved with modeling and simulation work. By 2014 he was teaching a Space Power Development Strategy course in the Equipment Academy graduate program.

Papers: Of the faculty identified in the video, Feng Shuxing appears to be at the less technical end of the spectrum, having focused on space strategy and space systems

analysis. His work over the past decade includes the following papers:

- Consideration Of Development Roadmap For A Chinese Space Communications Management System (2021)
- Analysis Of US Think Tank Global Space Threat And Space Warfare Capabilities Evaluation (2019)
- Research On Development Strategy Of Space Security Based On AHP-SWOT (2019)
- Requirement Analysis Of Aerospace Test For New Space Platform Using Quality Function Deployment (2015)
- Theoretical System For Research And Development Of China's Military In Space (2014)
- A Network Topology Clustering Algorithm For Service Identification (2012)
- Clustering Analysis Of Space Reconnaissance Intelligent Service Requirements In Presence Of Military Values (2011)
- Research On Simulation-Based Reconnaissance Mission Planning For Aerospace (2011)
- Simulation Design For Air Command Center Capabilities (2011)

Feng Shuxing



Source: sohu.com

Hong Yanji

History: Prof. Hong Yanji (洪延姬) was born in 1963. She graduated in 1984 with a bachelor's degree in science from the HIT Technology and Physics Department. Her early work assignments were in audiovisual equipment and at an agricultural college. In 1991 she entered the NUDT Applied Physics Department to study for a master's degree and then stayed on at this college's Applied Physics Department to complete her doctorate. In 1997 she started work in the China Engineering and Physics Research Institute's post-doctoral research station. In 2000 she transferred to the PLA Equipment Academy to teach. Her written work has focused on aerospace science and

Hong Yanji



Source: sohu.com

engineering, propulsion engineering, and antenna electronics. In 2014 she was listed as teaching a graduate course, Laser Space Applications and Technology. During 2018-2020 she was working in Space University's State Key Laboratory of Laser Propulsion and Applications.

Papers: Her academic journal articles are largely highly technical and have focused on laser technology and laser propulsion. Recent titles include the following:

- Method Of Optimal Spectral Lines Selection For Two-Dimensional Reconstruction Of Laser Absorption Spectroscopy (2020)
- Monte Carlo Analytical Method Of Impulse Measuring Noise Error For Laser Micro-Ablation (2018)
- Commentary On Combustion Application Research On Plasma Assist Combustion Mechanism And Its High-Speed Flow (2018)
- Study On The Influence Of Internal Shock Position On TDLAS Measurement Results In Isolator (2018)
- A Type Of Extremely Small Steady-State Thrust Reconstruction Method Based On Dynamic Compensation Technology (2018)
- Progress On Tunable Diode Laser Absorption Tomography Technique For Combustion Diagnostics (2018)
- Two-Dimensional Reconstruction Measurement Method Of Gas Temperature And Component Concentration Fields Based On Wavelength Modulation Spectroscopy (2018)
- Measurement Method For Gas Parameters In Combustion Flow Based On Spectroscopy Fitting (2017)
- Measurements Of Gas Parameters Based On The Laser Absorption Spectroscopy In Non-Uniform Flow (2017)
- Wavelength Modulation Spectroscopy For Measurements Of Gas Parameters In Combustion Fields (2017)

Patents: Hong Yanji also holds about 40 patents in the laser technology field. Patent titles for the last few years include the following:

- Method And System For Calculating Integral Absorbance Of Non-Uniform Flow Field (2020)
- Laser Absorption Spectrum Fault Reconstruction Light Distribution Optimization (2018)
- Displacement Measurement Errors Calibrating Device Based On Laser Interference (2018)
- Flow Field Survey System Integration Model Machine Based On Laser Absorption (2017)
- A Kind Of Coaxial Gas Electric Discharge Vacuum-Ultraviolet Light Source Device (2017)

- Fiber Array Optic Probe For The Field Measurement That Burns [sic] (2017)
- Plasma Enhancing Liquid Fuel Flammability Limits Research Device (2016)
- A Kind Of Fluid-Cooled Gas Metastable Atomic Beam Stream Generation Apparatus (2016)
- Disk Working Medium Disk Transmission-Type Laser Ablation Micro-Thruster (2016)

Sun Huayan

History: Prof. Sun Huayan (孙华燕) was born in 1963. Details of her academic history were not found, but journal article credits show that she was at the PLA Equipment Academy in the Opto-Electronic Equipment Department by 2013. She is credited with expertise in opto-electronic information processing and countermeasures.

Papers: Sun Huayan co-authored a book in 2012 entitled “Military Laser Technology” (军事激光技术). She is also the author of more than 60 journal articles. Over the last few years, these have been concentrated on laser technology, space laser communications, and space object detection. Papers published since 2018 have included the following titles:

- Effect Of Intensity Disturbance On Performance Of Dual-Frequency Laser Coherent Detection (2020)
- Analysis Of Influencing Factors Of Probing Difference Frequency Signals On Dual Frequency Laser Coherence (2020)
- Light Intensity And Spatial Coherence Characteristics Of Laser Coherent Detection In A Turbulent Atmosphere (2020)
- Intensity Distribution And Coherence Characteristics Of Partially Coherent Light In Horizontal Atmospheric Propagation (2020)
- Analysis Of LIDAR Receiving Characteristics Based On Four-Light Coherent Mixing Technology (2020)
- The Current Situation In Space Laser Communications Development And New Methods Of Network Organization (2019)
- Characteristic Analysis Of Target Laser One-Dimensional Range Profiles Based On Heterodyne Detection (2019)
- High Dynamic Range Image Synthesis For Space Target Observation (2019)
- Analysis On Influence Of Exposure Time In Ground-Based Photoelectric Detection (2018)

Sun Huayan



Source: sohu.com

- Survey Of The Application Of Camera Array In Space Target Observation (2018)

Patents: Sun Huayan also holds a number of patents for laser radar technology, laser communications, and object detection, including:

- Order Combination Automatic Processing Method, Device And System Based On Process Engine System (2019)
- A Kind Of Multiple Dimensioned Resolution Compression Perception Method For Reconstructing Between Encoding The Time-Out Multiple Constraints (2018)
- Laser Communication Fast Acquisition Alignment Methods Based On Retro-Reflective Properties (2018)
- Cat Eye Reverse Modulator Based On Focal Plane Imbalance (2017)
- Pinhole Camera Detection Method And Device Based On Double-Beam Alternate Emission (2017)
- Detection OF Inversely Modulated Based On Opal And Identification Device And Method (2017)
- Method For Improving Spatial Resolution Of APD Laser Radar Based On Phase Control Lattice Scanning (2017)
- A Kind Of Pinhole Camera Detection Method Based On Binocular Detection (2017)
- Reverse Modulation Laser Networking Communication System Based On Cat Eye Effect (2017)

Li Zhi

History: Sr Col Li Zhi (李智) was born in 1973 and is known as a computer simulation specialist. According to PLA biographic data, in 2003 he was given the lead of the Academy's first-ever simulation team, and was involved in distributed interactive simulation. In 2006 he was tasked with development of a training simulation system "for all space launch mission positions, systems, and processes" at the Jiuquan Satellite Launch Center. This included support to the Shenzhou series space launch missions. In recent years, Li Zhi's team has reportedly focused on big data and deep learning applications.

Li Zhi



Source: sohu.com

Papers: Li Zhi's written works have focused most recently on satellite imaging and space object identification. Recent titles include:

- Robust Method For Short-Arc Correlation Of Low Orbit Objects (2020)

- Multi-Satellite Imaging Planning Method With Optimal Response Time For Emergency Tasks (2020)
- Review Of Maritime Target Detection In Visible Bands Of Optical Remote Sensing Images (2020)
- Space Robot Link-Joint Mass Ratio And Inertia Ratio Analysis (2020)
- Clustering Analysis Of Space Object Characteristics Based On Convolutional Neural Network (2020)
- Research On Space Object's Materials Multi-Color Photometry Identification Based On Extreme Learning Machine Algorithm (2019)
- Intelligent Identification Of Space Objects Based On Data-Driven Method (2019)
- Influence Of Covering Material Wrinkles On Space Object's Optical Scattering Characteristics (2018)
- Comparison And Verification Of Satellite Optical Scattering Characteristics Based On Experimental Measurements And OCS Simulation (2018)

Patents: The only patent found under Li Zhi's name was entitled Method And Device For Cleaning Space Debris (2013).

Nie Wansheng

History: Prof. Nie Wansheng (聂万胜) was born in 1969 and is recognized as an expert in propulsion engineering and space launch technology. He holds a doctorate in Aerospace Advanced Theory and Engineering. Some sources connect him to NUDT, which may have been where he earned his doctorate. Journal credits indicate he was associated with the COSTIND Institute of Command Technology in 1997 and was assigned to the Equipment Academy's Space Equipment Department by 2002. He served in the General Equipment Department's Space Launch Technology Special Group, and was reportedly the technical lead for the 973 Project's "New Generation Liquid Booster Engine Unstable Combustion Mechanism and Suppression Methods Research."



Source: sohu.com

Papers: His early publications (1998-99) were already focused on rocket engine combustion technologies. He was also the co-author of a book published in 2011, "Liquid Booster Engine Combustion Dynamics Modeling and Numerical Calculation." Titles of his most recent papers are also focused on rocket engine and propulsion technologies:

- Plasma Hydrocarbon Free Radicals Influence Mechanism On Ethylene/Air Ignition (2018)
- Study On Heat Transfer Characteristics Of Compact Heat Exchanger (2018)
- Experiment And Internal Flow Field Numerical Simulation Of An Experiment-Scale Kero/Gox Liquid Rocket Engines (2018)
- Study On The Infrared Radiation Characteristics Of The Gox/Kero Engine Plume (2018)
- Influence Of The Standing Acoustic Wave On Laminar Flame Combustion (2018)
- Effect Of Actuating Voltage And Discharge Gap On Plasma-Assisted Detonation Initiation Process (2018)
- Influence Of Equivalence Ratio On Plasma-Assisted Detonation Initiation By Alternating-Current Dielectric Barrier Discharge Under Rich Burn Conditions (2017)
- Numerical Study Of Non-Equilibrium Plasma-Assisted Combustion On Spacecraft Rocket Engine (2017)

He has also published a number of recent works in the West through AIAA symposia or journals, including:

- Propagation Mode Analysis On H₂-Air Rotating Detonation Waves In A Hollow Combustor (2020)
- Experimental Investigation Of CH₄/Air Inverse Diffusion Flame Stabilization By Nonequilibrium Plasma (2019)
- Investigation On The Mechanism Of Thermo-Acoustic Instability Of N-Decane At Subcritical Pressure (2018)

Patents: Nie Wansheng's extensive collection of recent patents is likewise focused on rocket engine combustion:

- Phase Adjusting Device And Method For Fuel Droplets In High-Pressure And Acoustic Oscillation Environments (2020)
- Pintle Injector With Sweating And Cooling Functions (2020)
- Premixed Carbon Dioxide Pneumatic Laser Driven By Continuous Rotation Detonation Rocket Combustion (2019)
- Variable Thrust Continuous Detonation Rocket-Based Engine And Aircraft (2018)
- Engine Nozzle Carbon Deposition Removing Method Based On Low-Temperature Plasma (2019)
- Rocket Engine Injection Panel With Adjustable Nozzle Liquid Mist Distribution And Design Method (2018)
- A Kind Of Space Launch Rocket Drop Point Forecasting System (2017)
- A Kind Of Modularization Rocket Engine Propellant Biasing Spray Panel Of Threaded Connection (2017)

Cai Yuanwen

History: Sr Col Cai Yuanwen (蔡远文) was born in 1967 and is the current Director of Space University's Graduate College. He is credited with expertise in space vehicle testing and launch, aerospace science and engineering, automation technology, computer software, and computer applications. He graduated from NUDT in 1990 (probably his bachelor's degree graduation) and also has an advanced degree from the Beijing University of Aeronautics and Astronautics.

Papers: Cai Yuanwen does not have as many recent publications as some other Space University faculty members, but the papers found for the past ten years show a focus on quantitative analysis of space operations rather than space systems technology per se:

- Research On Model Error Of Small Satellite Serial Formation Based On Kinematic Method (2016)
- Research On Method Of Aerospace Test Resource Matching Optimization Based On Improved Genetic Algorithm (2012)
- Fault Detection Of On-Orbit Service Object Spacecraft Based On Rough Probability Petri Nets Model (2012)
- Carrier Rocket Pulse Signal Multiroute Integration Based On CPCI Computer Bus (2012)
- Research On Exo-Atmospheric Target Interception Strategy For Multiple Interceptions (2011)
- Analysis Of On-Orbit Defense And Service System Requirements Based On DoDAF (2011)
- CPN-Tools On-Orbit Service Concept Model (2011)
- Quantitative Analysis Of The Servicing Space Area Of An On-Orbit Service Vehicle (2011)
- Fault Detection Of On-Orbit Service Object Spacecraft Based On Fault Tree (2011)

Patents: Recent patents primarily show an expertise in gyroscope technology:

- Rotor Deflection Modulation Error Compensation Method Of Suspension Class Gyroscope (2016)

Cai Yuanwen

Source: sohu.com

- Flying Body Method For Measuring Angular Velocity Rotating Doppler Effect Based On Vortex Light (2016)
- Suspension Rotor Class Gyroscopic Drift Error High Accuracy Online Compensation Method (2015)
- Magnetically Suspended Gyroscope Of Magnetic Circuit Decoupling (2015)
- Two-Freedom External Rotor Permanent Magnet In Biased Spherical Radial Direction Magnetic Bearing (2014)

Conclusions

From what is known about the academic tracks of the Space University professors themselves, it appears they have been trained in a mix of well-known military and civilian universities. On the military side, the PLA National University of Defense Technology is most often mentioned. This is considered the premier military technical university in China. Similarly, the Harbin Institute of Technology that shows up in the resumes of several Space University professors is a highly regarded civilian engineering school, as is the Beijing University of Aeronautics and Astronautics cited as a source for one of the instructors.

Like the Space University curriculum, the ongoing research by these key faculty members (as documented in the papers they have published and the patents they were granted) could be seen as a template for China military space priorities writ large. The focus of work accomplished by the PLA's Space University almost certainly responds to national-level direction on China's space technology requirements. Thus, a distillation of faculty publication and patent topics, grouped as below, suggests the technological building blocks that China intends to use to achieve dominance in space:

- **Optical Imagery Technology:** multi-satellite imaging planning, opto-electronic information processing, and image fusion methods.
- **Laser Imaging Technology:** laser absorption spectroscopy, LIDAR receiver characteristics, and resolution of laser radar.
- **Satellite Data Transmission:** antenna technology for space information transmission, signal processing, satellite network topology.
- **Satellite Communications:** secure satellite transmission, space laser communications, and communications management systems.
- **Launch Vehicle Technology:** propulsion engineering and especially liquid booster engine combustion mechanisms.
- **Space Object Detection:** laser technology in space object detection and ground-based photoelectric detection.

- **Space Support To Combat:** satellite imagery intelligence in combat operations, space information support to air precision strike operations, and exo-atmospheric target interception strategy.
- **Artificial Intelligence Processes:** This appears to be an area of special emphasis in the research work of this faculty. Topics include multi-agent decision making, imaging satellite automatic detection methods, automatic image recognition equipment, space object identification based on machine learning algorithms, and space object characteristics analysis based on convolutional neural networks.

Postscript

One patent is perhaps worth highlighting as a sample of Space University research and for its novelty. This patent was granted to the Space University itself in 2020, and Nie Wansheng, the booster propulsion specialist described in the main text, was one of the applicants. It is titled “Premixed Carbon Dioxide Pneumatic Laser Driven By Continuous Rotation Detonation Rocket Combustion,” patent number CN110707521B. Its abstract is included below in its entirety, with highlighting on its proposed uses.

“The invention discloses a premixed carbon dioxide pneumatic laser driven by combustion of a continuous rotation detonation rocket, which comprises a continuous rotation detonation combustion device, a transition section and CO₂ pneumatic laser generating device and an exhaust section. The continuous rotation detonation combustion device is used for generating a high-temperature and high-pressure gas heat source which is used as a total energy source for downstream laser output; comprising a housing, a central cone, a rotating detonation combustor and an injection panel. The transition section enables the fuel gas after the combustion device to adapt to the change of configuration, and the fuel gas smoothly flows through the array spray pipe with the minimum total pressure loss. The pneumatic laser generating device comprises an array nozzle and an optical cavity. The exhaust section enables the product gas after light emitting to be rapidly exhausted to the outside. **The invention adopts the continuous rotation detonation rocket combustion device as a pumping source, so the efficiency of the produced laser is high, and the energy is saved. The device can be used on a rocket or a rocket-assisted aircraft, and can generate thrust and laser without increasing the load. And can also be used as a high-power continuous strong laser light source on the ground.**”