Profiling China's AI Developers:

China's Military National Innovation Institute of Defense Technology

Summary

China has created a military research center to develop artificial intelligence applications for weapon systems: the National Innovation Institute of Defense Technology, or NIIDT. This institute includes centers specifically for artificial intelligence (AI) and unmanned systems research. Its Director is Maj Gen Chen Xiaoqian, who has a background in space sciences and satellite technology. NIIDT was established in 2017 and is based in Beijing.

Emblem of the National Innovation Institute of Defense Technology

Source: sciencehr.net

The specific types of AI-enabled weapon systems China is pursuing are certainly of interest to the United States. Work being done at NIIDT is likely highly classified and is not discussed publicly. However, there are some facts about NIIDT that can be gleaned from unclassified Chinese sources. These sources include media accounts about its leadership, personnel recruiting announcements that give details of the research positions and needed expertise, academic journal articles by its research personnel, and patents filed by NIIDT.

The data gathered from these sources suggest that the main thrust of NIIDT research is on intelligent unmanned collective systems, in other words, **swarm robot weapons**. Many of the references found point to work on unmanned airborne swarm weapons. There are other references to "land, sea, and air robots and robot groups." Written work by Director Chen Xiaoqian has also discussed cluster spacecraft formations and autonomous spacecraft operations.

Other references reflect a robust artificial intelligence research effort but do not point to any specific type of weapon system. There is interest in neural science, pattern recognition, machine learning, and man-machine blended intelligent systems. The organizational division of research into an Artificial Intelligence Research Center and an Unmanned Systems Technology Center suggests that the former is developing AI systems for all applications and the latter works on the application of AI to swarm weapon systems.

Background

The impetus for this report was 2019 testimony given to the U.S.-China Economic and Security Review Commission on "Chinese Military Innovation in Artificial Intelligence," written by Elsa Kania from the Center for a New American Security (CNAS).[1] In her testimony, Kania identified the reorganization of the PLA Academy of Military Sciences (AMS) that included the formation in 2017 of a new entity, the National Innovation Institute of Defense Technology (NIIDT). She also identified that a new Artificial Intelligence Research Center is a component of NIIDT.

As a potential military locus for developing AI for weapon systems, NIIDT seemed worthy of a deeper look. This report is the result of research on the structure, leadership, and research focus of NIIDT using open source materials available on the Chinese-language Internet.

New AMS Research Entities

Chinese sources have identified NIIDT as a new entity subordinated to the Academy of Military Sciences and one of eight research centers established in 2017 as part of President Xi Jinping's military reforms. These components are shown in the chart below.

**New research institutes established under the Academy of Military Sciences**

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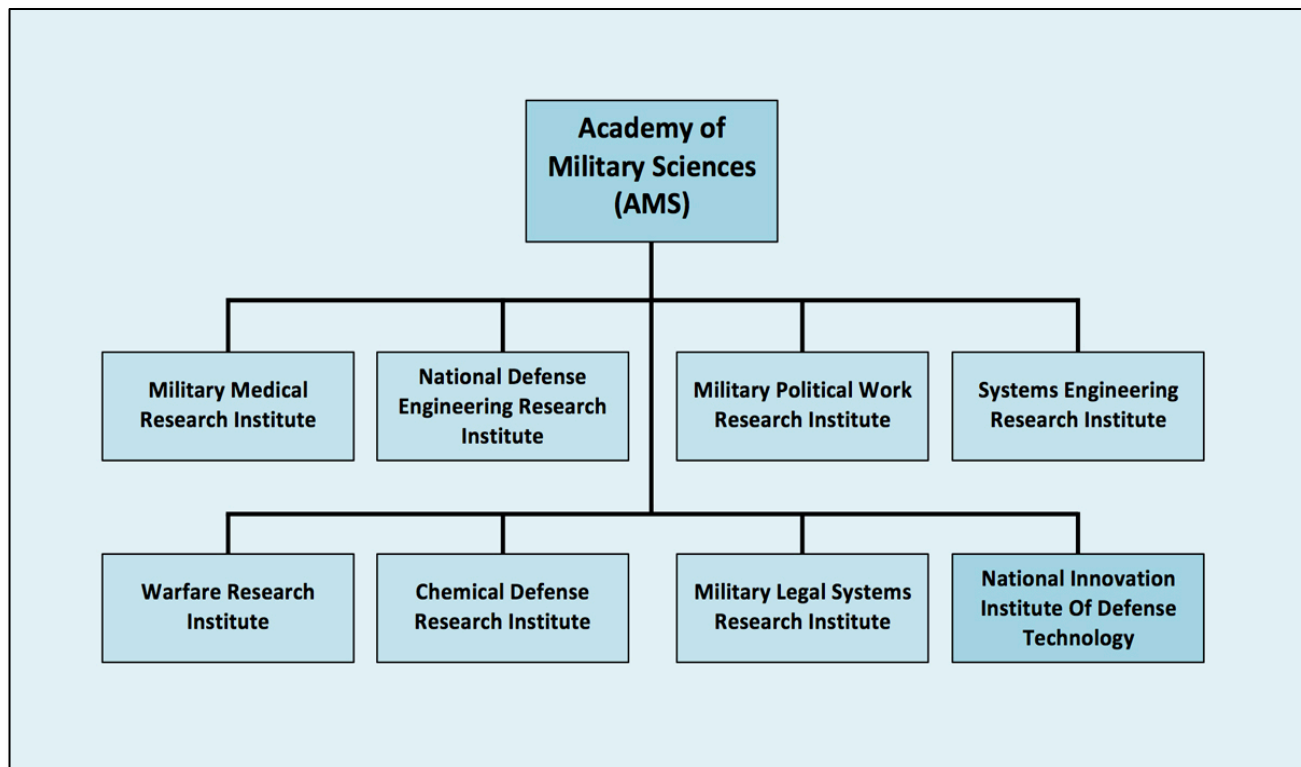
[1] See www.cnas.org/publications/congressional-testimony/chinese-military-innovation-in-artificial-intelligence.

Official postings have stated that NIIDT was established on 30 Sep 2017 as a scientific research organization subordinate to the AMS and is primarily focused on national defense S&T development strategy, device innovation, and basic technology research tasks. It conducts strategic, leading-edge, and basic research in national defense technology, with the primary lines of endeavor being artificial intelligence, unmanned systems, "bio-electromagnetics," and other emerging technologies. As described by these sources, NIIDT promotes national defense technology innovation, explores coordinated innovation through civil-military fusion, trains high-level scientific research personnel, and "promotes international technology exchange and cooperation."

This description identified seven administrative offices that are part of the headquarters of NIIDT (see chart below) and the five offices that comprise the division of the research work into main topics: development strategy, project coordination, artificial intelligence, unmanned systems, and "overlapping" technologies.

Organizational structure of NIIDT
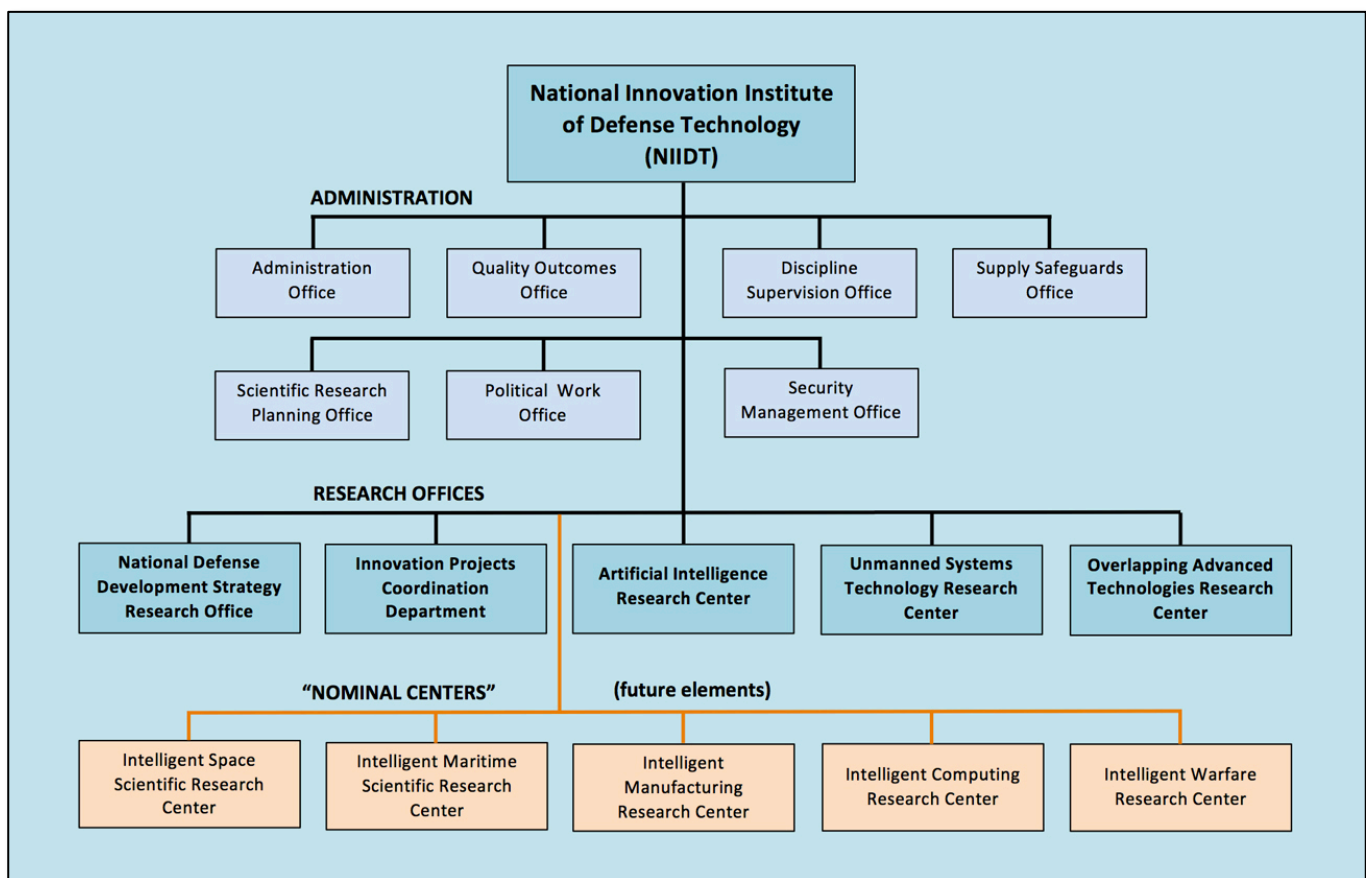
It was also noted that "in alliance with high-level universities, scientific research institutes, and high-tech companies in Beijing, Shanghai, Guangzhou, Tianjin, Changsha and other innovation resources concentration zones, NIIDT will establish five 'nominal centers'" (虚设中心)." The term as used here suggests that these five centers have been named but have not yet been established. The named centers appear at the bottom of the NIIDT chart.

In recruiting materials, NIIDT describes itself as an "all-forces military scientific research power" and a "high starting point for the preparation of development." They identify their mission as advanced scientific research fields in the areas that correspond to their research centers: artificial intelligence, unmanned systems technology, and overlapping cutting-edge technologies. Their recruiting solicitations also emphasize political criteria in what has apparently become standard language requiring adherence to the Party and its principles:

> "NIIDT is looking for those who wish to devote themselves to a career in national defense who are politically qualified, support the Chinese Communist Party, ardently love socialism, possess firm convictions, are of fine moral character, are well behaved, respect discipline and law, and show this every day."
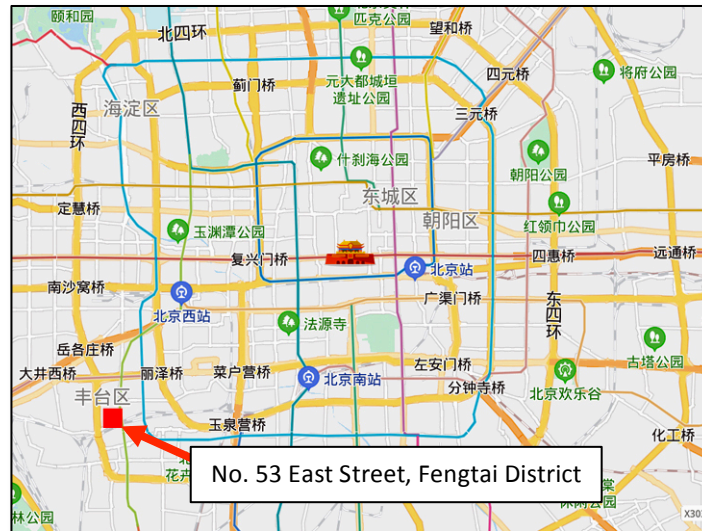
Location

Multiple references identify the address for NIIDT as No. 53 East Street, Fengtai District, Beijing. This address corresponds to a compound in southwest Beijing between the Third and Fourth Ring Roads (see map below). The address "No. 53 East Street" is embedded in a Chinese online map (see satellite image map below), reflecting the location of the main entrance.

In Chinese map systems, military facilities are rarely identified by name, and so no reference to NIIDT was found in Chinese maps. In this case, however, the compound at this address does include labels for a "81 Auditorium" and a "81 Guest House" (see satellite image). The numerals "81" are used to represent August 1 which is PLA Day in China, and so facilities identified with "81" are usually part of the PLA.

This compound was formerly associated with a branch of the Beijing Military Region Logistics Department. It is unclear whether that unit remains here as well or if NIIDT is now in full possession of the base.

Beijing City map

No. 53 East Street, Fengtai District

Source: baidu.com

Satellite image of compound at No. 53 East Street, Fengtai District

Approximate compound boundary

"August 1 Auditorium"

"No. 53 East Street"

New building

Location of main gate

"August 1 Guest House"

Source: baidu.com

An image of a military gate that was included in NIIDT recruitment materials (see below) matches the location of the "No. 53 East Street" notation in the satellite imagery above. Comparing this image with earlier ground-level photography shows that the gate, at least, has been refurbished. The sign next to the gate does in fact say, "PLA National Innovation Institute of Defense Technology." Satellite imagery also shows that a large new probable residential building has been constructed in the center of the compound since 2014, but it is unclear whether that structure is occupied now by the logistics unit or by NIIDT.

Image of the NIIDT main gate posted with job announcements

"PLA National Innovation Institute of Defense Technology"

Source: wemp.app

Leadership

Chen Xiaoqian

**NIIDT Director
Maj Gen Chen Xiaoqian**

The Director of NIIDT is Major General Chen Xiaoqian (陈小前). Chen Xiaoqian was born in September 1975. He entered the PLA National University of Defense Technology (NUDT) in 1991 and studied aerospace science for ten years from his undergraduate degree through to his doctorate. From 2010 to 2015 he served on the design teams for the satellite systems Tiantuo No. 1 and Tiantuo No. 3 which were developed at NUDT. From 2015 to 2017, Chen Xiaoqian was the Director of the College of Aerospace Science and

Source: pcl.ac.cn

Engineering at NUDT. He assumed leadership of NIIDT in 2019 after serving a period as its Deputy Director for day-to-day operations.

One profile of Chen Xiaoqian lists his areas of expertise as telecommunications technology, automation technology, computer software and computer applications. While on the NUDT faculty, Chen Xiaoqian was listed as adviser for three academic majors: Aerial Vehicle Overall Design and Systems Simulation, Micro Spacecraft and Collective Spaceflight Systems, and Rockets and Propulsion Technologies.

He is a prolific author on satellite operations and space robotics. In just the past year, he has authored journal articles on design of a soft robotic manipulator, group spacecraft formations and multi-obstacle avoidance, data downloading in optical satellite networks, and planning for spacecraft autonomy in on-orbit servicing missions. He also holds many patents in space technology and satellite communications. Recent patents cover inventions such as a self-driven expanding conical antenna, receiver tracking of low-earth-orbit satellites, a terahertz super-resolution micro-imaging system, and a kinematics model of a software mechanical arm. All of this work was dated during his tenure at NIIDT.

Diao Xingchun

**NIIDT Deputy Director
Maj Gen Diao Xingchun**

Major General Diao Xingchun is Deputy Director of NIIDT. He was born in 1964 in Jiangsu Province. He is the former Director of the PLA General Staff 63rd Research Institute in Nanjing (also known as the Nanjing Telecommunications and New Technology Research Institute). Deputy Director Diao has been in his position at NIIDT since at least 2018. He serves concurrently as Director of the Tianjin Artificial Intelligence Civil-Military Fusion Innovation Center, which operates in collaboration with NIIDT.

Source: pcl.ac.cn

Diao Xingchun holds a handful of patents dating from 2010 to 2015 when he was at the PLA 63rd Research Institute, dealing largely with computer modeling. Since 2010 he has also published three books (translated from English) on data quality. A review of his journal articles showed that his work focused on such programming esoterica as computer model resolution of multi-objective optimization problems, entity resolution in data integration and information retrieval, data generation problems with functional dependency, and database security mechanisms.

Although pictured above in civilian clothes, both Chen Xiaoqian and Diao Xingchun were pictured in uniform at a ceremony concluding a contract with the Tianjin Development Zone in 2018 (see below). Both were NIIDT Deputy Directors at the time. Chen Xiaoqian

is shown wearing the rank of senior colonel, but he has since been promoted to major general. Diao Xingchun is already wearing the rank of major general in this photo.

Chen Xiaoqian and Diao Xingchun in Tianjin in 2018

Source: teda.gov.cn

Identifying NIIDT's Research Focus

While NIIDT likely keeps its specific weapons research projects classified and out of sight, there are several aspects of their work that are knowable. For example, NIIDT advertises publicly for new research personnel, and they include in their solicitations some information on the positions available and the academic backgrounds they are looking for in candidates. The personnel doing the research at NIIDT also publish academic journal articles which may not describe weapons but do describe details of the research they have conducted. In addition, many NIIDT researchers have filed for patents for equipment or techniques that they have invented. Highlights from these three kinds of sources are shown in the sections below.

Recruiting Materials

Like other Chinese research facilities, their military research institutes often publish announcements of open academic positions. NIIDT participates in this process. For example, an NIIDT solicitation for post-doctorate civilian research personnel posted in

December 2018 gave some hints on the disciplines that were being pursued at that time. The solicitation included the names of the advisers at NIIDT for the various research areas that were seeking personnel. The table below shows the disciplines specified in this solicitation. It should be noted that Yang Xuejun, listed here in 2018 as an adviser for Computer Science and Technology, has since assumed the directorship of the Academy of Military Sciences, the next echelon above NIIDT.

NIIDT post-doctorate positions and advisers in 2018

ACADEMIC DISCIPLINE	ADVISER NAME	NAME
Aerostat Mechanical Arm Dynamics	Chen Xiaoqian	陈小前
Bio-Electromagnetic Information	Chang Shao	常 超
Civil-Military Fusion Theory and Practice	Lu Zhoulai	卢周来
Computer Science and Technology	Chen Xiaoqian	陈小前
Computer Science and Technology	Shi Dianxi	史殿习
Computer Science and Technology	Yan Li	闫 野
Computer Science and Technology	Yang Xuejun	杨学军
Control Science and Engineering	Liang Xiubing	梁秀兵
Control Science and Engineering	Yan Li	闫 野
Information and Telecommunications Engineering	Shen Tongsheng	沈同圣
Materials Processing Engineering	Liang Xiubing	梁秀兵
Pattern Recognition and Intelligent Systems	Dai Bin	戴 斌

Another "NIIDT Civilian Recruiting Announcement" issued in March 2019 gave specifics on the full-time research positions they were trying to fill at that time. All advertised positions were for "assistant research fellows" for work at the doctoral level. The chart below shows several of the key positions published, the number sought for that type of research, the academic background sought in candidates, and other requirements specified for these positions.

CHINA KEYHOLE

NIIDT positions and qualifications in 2019

POSITIONS	No.	ACADEMIC HISTORY	OTHER REQUIREMENTS
Aerospace Science and Technology Research	1	Control Science and Technology, Aerospace Science and Technology, Math 1	
Big Data Knowledge Mining Research	1	Pattern Recognition and Intelligent Systems, Computer Science and Technology, Math 1	Proficient grasp of data mining related technology
Communications Technology Research	1	Information and Telecommunications Engineering, Computer Science and Technology. Math 1	Limited to those with communications network or systems simulation expertise, familiar with Verilog and other hardware descriptive languages, implanted system hardware and software development
Computer and Applications Technology Research	2	Microelectronics and Solid-State Electronics, Computer Systems Structure, Math 1	
Computer and Applications Technology Research	2	Pattern Recognition and Intelligent Systems, Computer Science and Technology, Math 1	
Computer and Applications Technology Research	2	Control Science and Engineering, Computer Science, Math 1	
Large Electronic Information Equipment and Testing of National Defense Critical Technologies	1	Naval Architecture and Marine Engineering (Major), Aeronautical Engineering (Major), Math 2+, Physics	
Laser Technology Research	2	Optical Engineering, Math 2+, Physics	Familiar with all types of optical systems work principles, strong in scientific research work
Laser Technology Research	1	Optical Engineering, Math 2+, Physics	Limited to those with expertise in electro-optical engineering or image processing, principles of optical systems

POSITIONS	No.	ACADEMIC HISTORY	OTHER REQUIREMENTS
Materials Science and Engineering Research	1	Mechanics, Mechanical Engineering, Math 2+, Physics	Bachelor's degree in mechanical engineering, mastery of mechanical design software and mechanics functional analysis software
Materials Science and Engineering Research	1	Materials Science and Engineering, Math 2+, Physics	Familiar with ceramic-based composite materials preparation and knowledge of surface characteristics
New Optical Inertial Components Testing Research	1	Optical Engineering, Math 2+, Physics	Limited to those with expertise in electro-optical, light information, and quantum information, strong capability in scientific research
Oceanographic Scientific Research	2	Hydroacoustic Engineering, Math 2+, Physics	
Scientific Research Work	1	Chemical Engineering, Math 3+, Chemistry	Three years or more experience in scientific research work at military scientific research institutes or training organizations
Software Design and Development	1	Pattern Recognition and Intelligent Systems, Computer Software Theory, Math 1	
Telecommunications Technology Research	1	Electronics Science and Technology, Information and Telecommunications Engineering, Math 1	
Telecommunications Technology Research	1	Telecommunications and Information Systems, Computer Science and Technology, Math 1	
Telecommunications Technology Research	1	Signals and Information Processing, Math 2+, Physics	Strong in practical work

A mobile recruiting team also seeking to fill positions at NIIDT in 2019 stated that the primary disciplines available include computer science and technology, aviation and spaceflight science and technology, and electronic information. The specialties available in the computer science and technology discipline are shown in the chart below.

NIIDT disciplines identified in 2019

NIIDT Computer Science and Technology Specialties
Collective [Swarm] Intelligent Operating Systems
Electromagnetic Manipulation Theory and Technology
Intelligent Algorithm Research
Intelligent Chip Design, Software Radio Design
Intelligent Computers
Intelligent Unmanned Systems
Man-Machine Blended Intelligent Systems
Multi-Domain Intelligent Software
Parallel Learning Theory and Technology

The material from this team also elaborated on the robotics research under way at NIIDT:

> "By deploying collective robot intelligence theory and critical technology research, we have developed a morphable, intelligent, collective robot operating system (micROS) usable for land, sea, and air robots and robot groups. Through our research in unmanned systems and collective intelligent technology, we have developed heterogeneous unmanned platforms and intelligent load collective systems, applicable to intelligent collective unit task execution and intelligent unmanned systems."

Another solicitation issued in March 2020 enumerated the academic specialties involved in positions advertised for candidates at the graduate level and doctoral levels (see charts below).

Entry-Level Special Technical Positions (Graduate Student and Higher)	
Accounting	Literature
Administrative Management	Management Science and Engineering
Computer Science and Technology	Public Administration
Control Theory/Control Engineering	Philosophy
Info and Communications Engineering	

Mid-Level Special Technical Positions (Doctoral Candidate Level)	
Aircraft Design	Management Science and Engineering
Chemical Engineering and Technology	Maritime and Ocean Engineering
Computer Science and Technology	Materials Science and Engineering
Condensed Matter Physics	Mathematics
Control Science and Engineering	Microelectronics
Electronics Science and Technology	Neural Science
Hydroacoustic Engineering	Optical Engineering
Info and Communications Engineering	Physics
Instrument Science and Engineering	Software Engineering

Recruiting materials have claimed that the proportion of PhD's in NIIDT's technology research centers is 100 percent, and about one third of all scientific research personnel possess overseas study experience. They also highlighted NIIDT wages as follows:

> "For higher education graduates admitted to Beijing specialist technology positions, monthly wages for those with a bachelor's degree are about 11,000 yuan [about $1,550]; for a master's degree, 12,000 yuan [$1,700]; and for doctorate holders, about 15,000 yuan [$2,150]. These wages are given following a probation period and include housing allowance and scientific research position subsidy for first-line civilian personnel."

Academic Papers

A look at the journal articles published by NIIDT researchers in the last few years shows expertise and interest in unmanned vehicles, composite materials, and structural integrity. A selection of titles from the last two years is shown in the table below.

Recent academic articles by NIIDT personnel

JOURNAL ARTICLE	PUBLISHED
Research On Multiple Unmanned Vehicle Communications Connectivity Preservation Based On Dynamic Programming	2020
Quasi-Static Compression Energy Absorption Mechanism Of Filament Wound Composite Constrained Spherical Buoyancy Core Material	2020
Curved Energy Dissipation Mechanism For Glass Fiber/Resin Composite Material Double Layer Laminated Foam Board	2019
Simulation Analysis On The Protection Characteristics Of External Multilayer Array Structures Of Double-Hull Submarines	2019
Advances In Electroless Plating On Nonmetals	2019
Development and Application Of Laser Cleaning Technology	2019
Numerical Simulation Of Tip Stress Field Of Semi-Circular Initial Crack Subjected To Alternating Tensile Loads	2019
Indentation Mechanical Model and Deformation Coordination Mechanism Of Composite Spherical Array Sandwich Structure	2019
On The Crash Mechanism Of Bulbous Bow With Rigid Body and Ice Load	2019
Influence Of Aircraft Carrier Corridor Configuration On Evacuation Performance	2018

Patents

Chinese patent applications of all types are posted online in several locations both in China and abroad. The following is a list of patents applied for since its founding by NIIDT personnel who appear to work in the Artificial Intelligence Research Center of this organization (filing date follows the patent name):

Recent patents filed by NIIDT personnel

PATENT TITLE	FILED
Method and System For Unmanned Aerial Vehicle Cluster Cooperative Landing Sequencing	2020
FPGA (Field Programmable Gate Array) Verification Platform and Method For SoC (System On Chip)	2020
Deadlock Detection Circuit and Detection Method For Asynchronous Pipeline Circuit	2020
Double-Track Signal Asynchronous Transmission Link System	2019
Group Unmanned System Cooperative Task Management Subsystem Based On Role State Machine	2019
Role-Based Cooperative Task Management Method For Unmanned Group System	2019
Method and Device For Multi-Agent Confrontation Strategy Intelligent Prediction	2019
Method and Device for Multi-Agent Confrontation-Oriented Reinforcement Learning Training Optimization	2019
Self-Adaptive Resource Management Method and Device For Distributed Reinforcement Learning Training	2019
Method and Management Platform For Autonomous Unmanned Cluster Dynamic Management	2019
Method and System For Fast Full-Text Retrieval Between Corpora	2019
Detecting Probe Method and Device For Supporting User Space Real-Time Task Dispatch	2019
Self-Adapting Data Distribution Method Suitable For Unmanned Plane Group	2018
Robot System for Multiband Autonomous Channel Mass Measurement	2018
Robot System For Measuring Multi-Frequency-Band Autonomous Channel Quality	2018

Comments

What can be inferred, then, from the information culled from the sources outlined above? What is NIIDT working on? Some conclusions can be drawn from the various topics that appear in these sources.

The most dominant topic found in NIIDT job descriptions, papers, and patents appears to be intelligent unmanned collective systems, in other words, **swarm robot weapons**. The Chinese term "qunti" {群体}, often translated by NIIDT researchers as "collective" or

"swarm," turns up again and again. Repeated references found in the sources to "collective intelligence" (群体智能), "collective robot operating systems" (群体机器人操作系统), and "multiple intelligent entity combat" (多智能体对抗) point to this category of weapon as a major goal for NIIDT research and development. Patents include work on "multiple unmanned vehicle communications connectivity." The presence of an Artificial Intelligence Research Center and an Unmanned Systems Technology Research Center as two of the five research centers that comprise NIIDT also suggests that AI-enabled autonomous weapons are the key focus of the NIIDT research effort as a whole.

The scope of work on swarm weapons appears to include airborne, space, underwater, and possibly land-based collective systems. There are repeated solicitations for personnel with aerospace science and engineering backgrounds. There are references to "unmanned aircraft groups" and patents for "unmanned aerial vehicle cluster cooperation." There was less data found on space-based systems, but recent written work by Director Chen Xiaoqian did discuss cluster spacecraft formations and autonomous spacecraft operations. There are fewer references to autonomous naval weapons but advertised position requirements and patents for submarine components indicate there is an obvious interest in maritime engineering. Land-based systems may also be part of this research effort. There are references to "land, sea, and air robots and robot groups" as well as to "heterogeneous unmanned platforms," but few other obvious references to land-based systems.

There are other data points that reflect the overall AI research effort but do not point to any specific type of weapon system. The appearance of interest in neural science and man-machine blended intelligent systems likely reflects work being done in the Artificial Intelligence Research Center. Position requirements repeatedly call for personnel with backgrounds in pattern recognition and intelligent systems. A reference to parallel learning theory and technology appears to point to work in machine learning. The division of research into an Artificial Intelligence Research Center and an Unmanned Systems Technology Center suggests that the former is developing AI systems for all uses and the latter works on the application of AI to swarm weapon systems.

The remaining indicators found show the breadth of the research effort but again do not suggest any particular weapon system. The key technologies that appear to be part of NIIDT work include laser technology, telecommunications engineering, and materials processing. Materials development research at NIIDT appears to cover a range that includes ceramic-based composite materials, glass fiber/resin composite materials, and plating on nonmetals. Papers and patents that include terms like "spherical buoyancy core material," "multilayer array structures of double-hull submarines," and "bulbous bow with rigid body" point to development for naval applications.

Other references are more obscure. There appears to be work under way involving implanted system microelectronics, quantum information, and "bio-electromagnetic information," but it is not clear what weapons this work could be applied to.

In sum, the creation of NIIDT and what can be known about its operations indicate a well-funded Chinese military effort to advance AI-enabled weapons development. Autonomous robot group weapons appear to be at the core of NIIDT research. The remaining research work may be in support of swarm weapons or of other categories of weapons. In any event, tracking the work at NIIDT, to the extent this is possible, may continue to be useful in understanding the threats posed by emerging Chinese combat systems.