

Picking flowers, making honey

The Chinese military's collaboration
with foreign universities

Alex Joske



About the author

Alex Joske is a Researcher working with the International Cyber Policy Centre.

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What's the problem?

China's People's Liberation Army (PLA) is expanding its research collaboration with universities outside of China. Since 2007, the PLA has sponsored more than 2,500 military scientists and engineers to study abroad and has developed relationships with researchers and institutions across the globe.¹ This collaboration is highest in the Five Eyes countries, Germany and Singapore, and is often unintentionally supported by taxpayer funds.² Australia has been engaged in the highest level of PLA collaboration among Five Eyes countries *per capita*, at six times the level in the US. Nearly all PLA scientists sent abroad are Chinese Communist Party (CCP) members who return to China on time. Dozens of PLA scientists have obscured their military affiliations to travel to Five Eyes countries and the European Union, including at least 17 to Australia, where they work in areas such as hypersonic missiles and navigation technology. Those countries don't count China as a security ally but rather treat it as one of their main intelligence adversaries.³

The activities discussed in this paper, described by the PLA as a process of 'picking flowers in foreign lands to make honey in China' (异国采花·中华酿蜜), risk harming the West's strategic advantage.⁴ Helping a rival military develop its expertise and technology isn't in the national interest, yet it's not clear that Western universities and governments are fully aware of this phenomenon.⁵ Some universities have failed to respond to legitimate security concerns in their engagement with China. Current policies by governments and universities have not fully addressed issues like the transfer of knowledge and technology through collaboration with the PLA. Clear government policy towards universities working with the PLA is also lacking.⁶

What's the solution?

Understanding and responding to PLA collaboration will require closer engagement between governments and universities. While universities haven't self-regulated on this issue and haven't controlled the associated security risks, universities and researchers will not effectively limit the risks of PLA collaboration on their own until governments develop clear policies on it. Governments need to explore a wider range of tools for limiting technology transfer, including better scrutiny of visa applications by Chinese military scientists and further legislation targeting military end users. Governments should also consider increasing funding to strategic science and technology fields, while actively limiting problematic foreign investment in those fields. Universities must recognise the risks of such collaboration and seek to learn the extent and nature of their collaboration with the PLA by actively working with government, civil society and security professionals.



Introduction

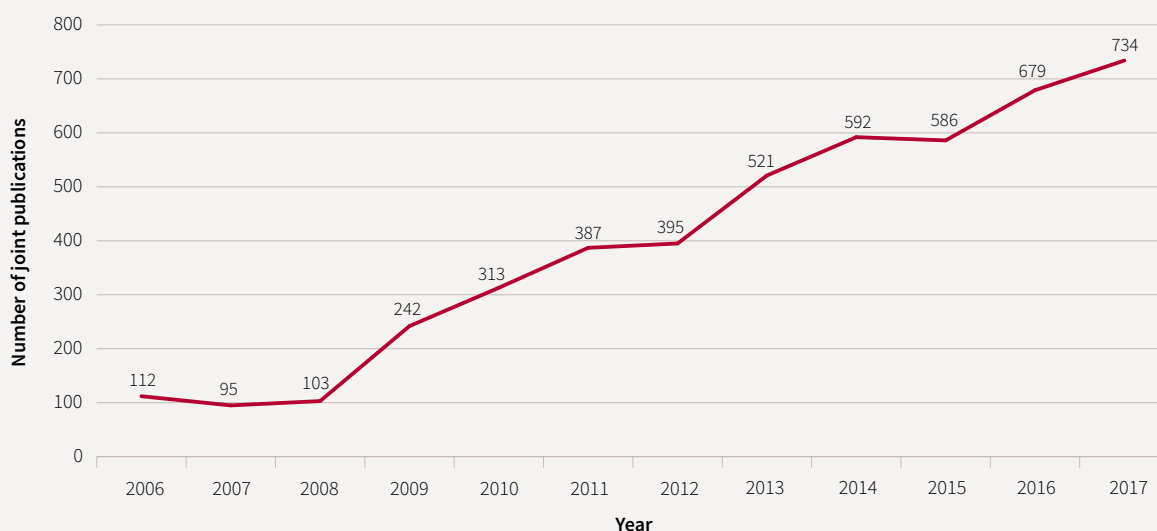
In 2017, the head of the American Association for the Advancement of Science said that ‘Scientific progress depends on openness, transparency and the free flow of ideas.’⁷ This collaborative and open spirit, including collaboration with Chinese scientists, has led to some of the great scientific achievements of recent times.⁸

While countries such as Australia and the US pride themselves on their scientific achievements, their universities and research institutes face limited or declining domestic funding.⁹ To address these issues, many universities have turned to China—an emerging scientific powerhouse that has sought to build ties to scientific communities around the world.¹⁰ This collaboration has generally been a productive and welcome part of the Australia–China relationship.

The Chinese military has also ridden this wave of research collaboration, sponsoring more than 2,500 scientists to travel to universities in technologically advanced countries such as Australia as students or visiting scholars over the past decade.¹¹ The volume of peer-reviewed literature produced by PLA scientists in collaboration with foreign scientists each year has grown steadily since 2008, following increases in the number of PLA scientists sent abroad (Figure 1).¹² Those scientists work in strategic and emerging technology sectors such as quantum physics, signal processing, cryptography, navigation technology and autonomous vehicles.

The PLA’s program of sending scientists abroad is different from standard military exchanges, in which military officers visit each other’s institutions. Those open exchanges build understanding, communication and relationships between militaries.

Figure 1: PLA collaboration, as measured by the number of peer-reviewed articles co-authored by PLA scientists with overseas scientists, 2006 to 2017



Source: Scopus.

In contrast, the PLA National University of Defense Technology (NUDT, 解放军国防科学技术大学) appears to conceive of its military exchanges separately from its international research ties, which are concentrated in foreign universities and not military institutions.¹³ Scientists sent abroad by the PLA have minimal or no interaction with military personnel in their host countries. Some of those travelling overseas have actively used cover to disguise their military affiliations, claiming to be from non-existent academic institutions.

Around half of those sent abroad are PhD scholars who either complete their doctorates overseas or spend up to two years as visiting PhD scholars and who can usually be identified by searching peer-reviewed literature. While most come from NUDT, the Army Engineering University is another major source.¹⁴ The remaining half are sent overseas for short-term trips, spending up to a year as visiting scholars. Few of those scientists have left online traces of their time overseas.

While foreign universities' ties with the PLA have grown, it isn't clear that universities have developed an understanding of the PLA and how their collaboration with it differs from familiar forms of scientific collaboration. To date, there's been no significant public discussion on why universities should be directly contributing to the technology of a non-allied military. Importantly, there's also little evidence that universities are making any meaningful distinction between collaboration with the Chinese military and the rest of their collaboration with China.

A handful of universities have strongly defended their collaboration with the PLA. Among universities in Five Eyes countries, the University of New South Wales (UNSW) has published the most peer-reviewed literature in collaboration with PLA scientists. After attracting scrutiny for this collaboration, the university's deputy vice-chancellor wrote, 'Any fears that our intellectual property or security is undermined through our work with international partners are entirely unfounded.'¹⁵

Australia's Curtin University has described its collaboration with the PLA in similar terms, insisting that work by its scientists with PLA experts on explosions and projectiles doesn't violate any laws and is civilian research.¹⁶

Government research agencies have also engaged in collaboration with the PLA. For example, researchers at the Australian Government's Commonwealth Scientific and Industrial Research Organisation (CSIRO) have collaborated with NUDT scientists on cloud computing technology. Those same NUDT scientists were using cloud computing technology for combat simulations.¹⁷

Large sums of government funds have been used for collaboration with PLA scientists. One professor at UNSW, for instance, worked with PLA scientists using Australian Research Council grants worth \$2.3 million.¹⁸ Internationally, defence funding has also been used for research with PLA scientists; for example, a paper written by University of Manchester scientists with a visiting student from NUDT lists US Air Force and Navy grants as funding sources.¹⁹



International military–civil fusion

In China, the PLA's overseas research collaboration is described in frank terms. The *PLA Daily* uses the saying 'Picking flowers in foreign lands to make honey in China' to explain how it seeks to leverage overseas expertise, research and training to develop better military technology.²⁰

This is one aspect of what China calls 'military–civil fusion' (军民融合). The term refers to China's efforts to improve its military's ability to take advantage of the creativity of the civilian sector and develop its own indigenous military–industrial complex. Described by PLA experts as a 'cornerstone of PRC national defense reform', military–civil fusion is helping to drive the modernisation of the PLA.²¹ So important is military–civil fusion to President Xi Jinping's military reforms that he described it earlier this year as a prerequisite for building strategic capabilities and a strong military.²²

Illustrating the benefits that the PLA obtains from its overseas research collaboration, a publication run by China's Ministry of Education stated that NUDT's collaboration with the University of Cambridge to train visiting PLA students will 'greatly raise the nation's power in the fields of national defence, communications, anti-jamming for imaging and high-precision navigation'.²³ Likewise, before travelling to Sweden for doctoral studies in quantum physics, an NUDT scientist was told by his supervisor, 'Without breakthroughs in physics, how can there be rapid developments in weaponry?'²⁴

Figure 2: Lieutenant General Yang Xuejun (2nd from right) and Xi Jinping, chairman of the Central Military Commission, in July 2017



Source: 'Xi Jinping confers flags and delivers instructions to the Academy of Military Sciences, National Defense University, and National University of Defense Technology', Xinhuanet, 19 July 2017, [online](#).

Lieutenant-General Yang Xuejun (杨学军, Figure 2), who oversaw a substantial rise in NUDT's overseas links when he was its president from 2011 to 2017, appears to be one of the key figures behind this phenomenon. NUDT, as the Chinese military's largest science and technology university, can be seen as representative of broader initiatives in this area. The university is the main source of PLA scientists studying abroad and by 2013 had reportedly sent more than 1,600 scientists overseas as students or visiting scholars, including roughly a third of its PhD scholars.²⁵ An article written by NUDT scholars claims that the university received 300m renminbi (\$A60m) from the Chinese government to send 765 graduate students to study abroad.²⁶ According to General Yang, who has implied that NUDT's overseas ties are a form of military-civil fusion, the university 'has already reaped great benefits from going down the open university path and the military-civil fusion road'.²⁷

General Yang's recent promotion to membership of the 205-member 19th CCP Central Committee and to leadership of the Academy of Military Sciences, the PLA's premier research institution, reflects Xi Jinping's emphasis on 'rejuvenating the military with science and technology'.²⁸ It was probably also a recognition of the success with which Yang developed NUDT's international ties.

Yang, himself a supercomputer expert, has collaborated extensively with UNSW and ran the program to develop the Tianhe-1A supercomputer, once ranked as the world's fastest supercomputer.²⁹ The NUDT supercomputer program's role in nuclear weapons testing led to NUDT being placed on the US Government's Entity List in 2015, meaning that the university faces stricter export controls, yet substantial numbers of NUDT scientists continue to train outside China, including in the US, the UK and Australia.³⁰

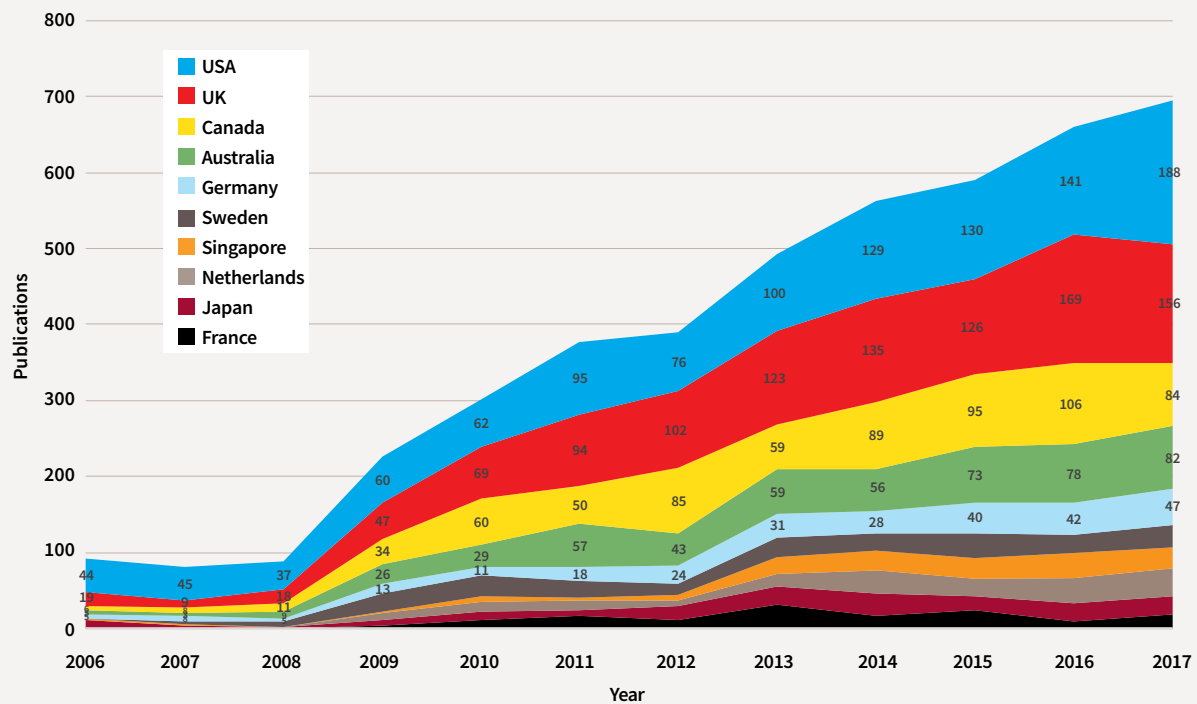
The PLA encourages scientists to work on areas of interest to the military while they're overseas. For example, a 2016 article by NUDT specialists in graduate student education recommends that, in choosing where to study overseas, students' first priority should be the relevance of the research direction of an overseas institution to their work in China, as they 'must comprehensively consider the continuity of their research work when in China with that when they are studying overseas'.³¹ When students are overseas, the report adds, they should 'fully take advantage of the cutting-edge research conditions and environment abroad' and 'map out the arrangements of their overseas research and their plans for research after returning to China'. This alignment of domestic and overseas work indicates that the cases of PLA scientists gaining skills while in Australia that they then use for military projects aren't outliers; they're representative examples.³²



Sources of and destinations for PLA scientists

PLA scientists come from a wide range of institutions and disciplines within the Chinese military. Analysing peer-reviewed publications co-authored by PLA scientists and overseas scientists indicates that the US, the UK, Canada, Australia and Germany were, in that order, the top five countries engaged in research collaboration with the PLA in 2017 (Figure 3). Those countries appear to be the primary destinations for PLA scientists sent abroad.

Figure 3: The top 10 countries for PLA collaboration, as measured by peer-reviewed literature co-authored by PLA scientists, 2006 to 2017



Source: Scopus.

PLA scientists sent abroad as visiting scholars came from institutions such as:

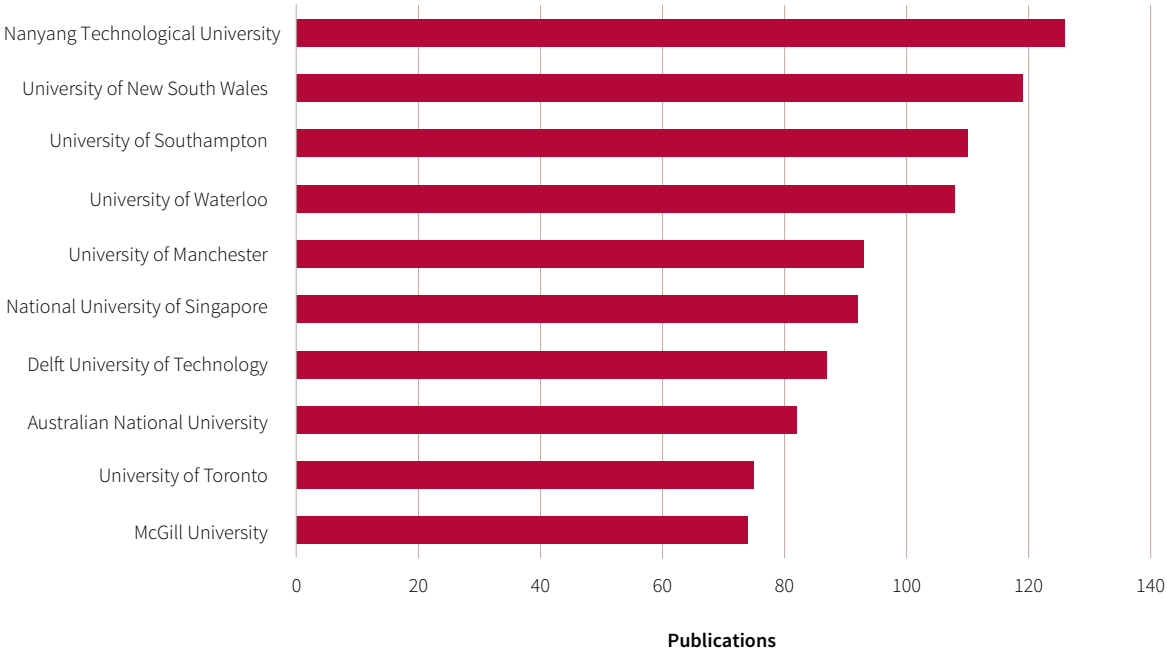
- the Northwestern Institute of Nuclear Technology (西北核技术研究所), which works on nuclear and high-power microwave weapons
- the Chemical Defense Institute of the Academy of Military Sciences (军事科学院防化研究院), which specialises in chemical weapons research and has sent a sarin gas expert overseas
- the Navy Submarine Academy (海军潜艇学院) in Qingdao
- the Armored Forces Engineering Academy (装甲兵工程学院) in Beijing, which works on tank technology
- the China Aerodynamics Research and Development Center (中国空气动力研究与发展中心), which has sent scramjet researchers to study overseas
- the Rocket Force Engineering University (火箭军工程大学), which conducts research for China's missile programs
- the Academy of Equipment Command and Technology (装备指挥技术学院), which in 2007 sent a specialist in antisatellite weaponry to the University of Michigan using civilian cover.³³

The volume of peer-reviewed literature co-authored by PLA researchers and overseas researchers is a rough indicator of the level of PLA collaboration at each university. Figure 3 shows that the leading countries for PLA collaboration by this measure for 2017 were, in order, the US, the UK, Canada, Australia and Germany, indicating that they're likely to be the main destinations for PLA scientists studying abroad. Singapore, Sweden and the Netherlands are other major destinations for PLA scientists. Over the past decade, Australia has been engaged in the highest level of this collaboration among the Five Eyes countries *per capita*, at six times the level in the US.

It's also possible to estimate the number of PLA scientists sent to each country since 2007, based on the above findings.³⁴ Approximately 500 Chinese military scientists were sent to each of the UK and the US, roughly 300 each to Australia and Canada and more than 100 each to Germany and Singapore. Hundreds more have been sent to other countries, including the Netherlands, Sweden, Japan and France.

Figure 4, using the same dataset, shows the top 10 universities outside China for PLA collaboration. Nanyang Technological University in Singapore has the highest level of PLA collaboration, followed closely by UNSW in Australia. Other universities in Canada, Australia, the UK and the Netherlands also engage in high levels of collaboration with the PLA.³⁵

Figure 4: The top 10 universities outside of China for PLA collaboration, as measured by the number of peer-reviewed publications, 2006 to 2017



Source: Scopus.

The PLA's links to universities across the world go beyond student admissions. The Chinese military, through its own universities and research institutions, has worked to build relationships with overseas universities and leading overseas researchers. A 2014 document published by NUDT claimed that the university had recruited 20 foreign nationals as teachers and 'established academic relationships with over 100 universities and research units in over 50 countries and regions'.³⁶



Scientists from Australia, the UK and the US are listed as potential doctoral supervisors for NUDT students in 2018.³⁷

NUDT has also built ties with overseas universities at the institutional level. For example, NUDT's Quantum Information Interdisciplinary Talent Training Program cooperates with the University of Cambridge's Cavendish Laboratory.³⁸ The *People's Daily* claimed that, in addition to agreements with Oxford and Cambridge, NUDT has established 'overseas study bases' at institutions including Harvard University.³⁹ New Zealand's Massey University also signed a memorandum of understanding with NUDT in 2008.⁴⁰

Maintaining loyalty to the CCP

The PLA, as the armed wing of the CCP, insists that all overseas party members strictly abide by 'external exchange discipline standards'.⁴¹ According to the *PLA Daily*, 'the openness of internationally expanding talent cultivation does not represent a "relaxation", and we certainly cannot "let go"'.⁴² General Yang Xuejun has also specifically warned of the need to carefully manage military secrets while increasing the university's openness.⁴³

Those permitted to study overseas go through intensive training prior to their departure and are 'all budding shoots with good grades and strong potential for innovation'.⁴⁴ Alongside academic credentials, political credentials are also of key importance for military scientists hoping to study abroad. The *PLA Daily* warns that, if students sent overseas 'develop issues with their politics and ideology, the consequences would be inconceivable (后果不堪设想)'.⁴⁵ NUDT therefore appears to sponsor only CCP members for overseas study and works hard to maintain their loyalty to the party and negate 'all kinds of harmful ideologies'.⁴⁶ Reportedly, all 200 students and researchers from NUDT who were studying or visiting overseas in 2013 were party members.⁴⁷

The *People's Daily* claimed in 2013 that students sent overseas by NUDT had established eight party branches overseas and organised events for party members, so that 'personnel studying abroad would keep their convictions rock-solid' (坚守信念如磐).⁴⁸ Another report from 2015 claimed that NUDT's College of Optoelectric Science and Engineering alone had established 10 overseas party branches.⁴⁹ More recent reports hint that such branches are still being established. For example, party media reported in October 2017 that students from one of NUDT's colleges had established a WeChat group for the college's more than 30 students overseas to study the 19th Party Congress.⁵⁰ 'Their red hearts,' the report concluded, 'look to the party.'

Party branches have also been used to coerce overseas Chinese scholars. An investigation by *Foreign Policy* found that some visiting students from Chinese universities who formed party branches abroad were asked to report on any subversive opinions held by their classmates.⁵¹ It's probable that similar kinds of pressure are exerted on overseas PLA researchers.

Online communication forms an important part of PLA efforts to maintain discipline among overseas personnel and is complemented by in-person contact. One report stated that students from NUDT's College of Optoelectric Science and Engineering 'regularly chat with College leaders by video call and exchange emails with NUDT academic supervisors and student cadres to discuss their thoughts, exchange ideas on academic matters, and clarify points of interest'.⁵² Regulations on the political education of overseas students by the same NUDT college include provisions for 'overseas inspection' and for students to return to China in the middle of their study for 'remedial education'. One NUDT professor used a trip to an overseas conference as an opportunity to meet eight NUDT scientists studying in the region to 'pass on the greetings and requests of party organisations'. The regulations also include provisions for 'joint education and interaction with families', which may imply that pressure on the family members of overseas PLA scientists is used to maintain discipline.⁵³

The close watch that the PLA keeps on its overseas scientists helps ensure that all those sent abroad return to the Chinese military. NUDT, for example, requires that those applying to study abroad show their intent to return to 'serve the construction of the nation, national defence and the military'.⁵⁴ The *PLA Daily* claimed in 2013 that all the students whom NUDT had sent abroad in recent years returned on time to 'become key forces in their work units'.⁵⁵

Institutes that don't exist: deception by PLA scientists

While most scientists sent abroad by the PLA appear to be open about which institutions they come from, this report has identified two dozen new cases of PLA scientists travelling abroad using cover to obscure their military affiliations. In at least 17 of these cases, PLA scientists used cover to travel to Australia. These scientists use various kinds of cover, ranging from the use of misleading historical names for their institutions to the use of names of non-existent institutions.

Features of deception by the PLA

An article from 2002 on the website of a Chinese overseas study agency offers insights into the use of cover. In response to a question asking whether having graduated from a military institution would affect one's ability to get an overseas visa, the company responded:

Many military colleges and military units externally have common names (民间称呼) that don't reveal their military characteristics. NUDT, for example, is externally known as Changsha Institute of Technology. This is the best way [to avoid having your visa application rejected].⁵⁶

The Changsha Institute of Technology was a PLA institution subsumed by NUDT in 1975.⁵⁷ While the quote above doesn't come from an official source, it at least indicates how these unsophisticated but nonetheless effective covers are understood as tools for hiding one's military background.

Besides using non-existent institutions with innocuous-sounding names as cover, PLA members also claim to be from real civilian institutions in the same regions as their military units. New Zealand MP Yang Jian, for example, who taught intelligence officers at the PLA Foreign Languages Institute in Luoyang, claimed in his New Zealand residency application to have worked at Luoyang University.⁵⁸ Before moving to New Zealand in 1999, Yang received an Australian Government aid scholarship to study at the Australian National University, earning a master's degree and doctorate in international relations. During that period, he interned at the Senate Standing Committee on Foreign Affairs, Defence and Trade, and headed the Canberra Chinese Students and Scholars Association, which retains intimate ties to the Chinese Embassy to this day.⁵⁹ Yang told media, 'the system asked me to use the partner university,' referring to Luoyang University.⁶⁰

A number of PLA scientists using cover to travel abroad have created LinkedIn profiles using their cover institutions, which may have been used to shore up their claimed affiliations while overseas.⁶¹

The use of cover appears to be managed differently by each institution, some of which use cover far more often than others.⁶² Cover is also not used consistently within each institution. As described below, PLA Information Engineering University (PLAIEU) researchers have both used cover and openly stated their affiliation at the same conferences. It's unclear whether this indicates that the use of cover is up to the discretion of each researcher or perhaps that it relates to the sensitivity of a researcher's work or position in the PLA.

NUDT appears to no longer use the 'Changsha Institute of Technology' as cover, but it engages in a different kind of deception. A document published by NUDT for students hoping to study abroad advises them that, when providing documentation in their applications to foreign institutions, 'military and political courses can be excluded' from their academic records.⁶³ This appears designed to mislead overseas authorities, universities and researchers by downplaying the extent to which NUDT is a military institution and to which these students are military scientists.

The Xi'an Research Institute of High Technology

Scientists from the PLA Rocket Force Engineering University (RFEU, 火箭军工程大学)⁶⁴, a key research base for the PLA Rocket Force, claim to be from the 'Xi'an Research Institute of High Technology' (西安高技术研究所), which appears to only exist on paper.

At least five RFEU scientists claiming to be from the Xi'an Research Institute have travelled overseas as visiting scholars, including one of the PLA's leading missile experts, Major General Hu Changhua (胡昌华), and three of his close associates at RFEU. General Hu (Figure 5), who heads RFEU's Missile Testing and Control Simulation Experimental Teaching Centre, visited the University of Duisburg-Essen in Germany for four months in 2008.⁶⁵ It's unclear what he worked on in Germany, as he didn't publish any papers while there, but his work for the PLA focuses on flight control systems and fault diagnosis for missiles.⁶⁶

Two RFEU scientists who frequently publish with Hu, Zhou Zhijie (周志杰)⁶⁷ and Wang Zhaoqiang (王兆强),⁶⁸ were visiting scholars at universities in England; they claim in their English publications to be from the Xi'an Research Institute.⁶⁹

Figure 5: Major General Hu Changhua, profiled by China Central Television’s military affairs channel in 2016: ‘Right now I’m a professor at RFEU and head of the Military Key Lab on Missile Testing and Control Technology.’



Source: CCTV, 28 October 2016, YouTube.

Hu Xiaoxiang: a case study

Identifying the Xi’an Research Institute of High Technology as a cover institute helps shed light on the January 2015 expulsion from Norway of a Chinese scientist and his supervisor, a dual citizen of Germany and Iran. The expulsion came after Norwegian authorities determined that the work of the Chinese scientist, later named in court as Hu Xiaoxiang (扈晓翔), could be used to develop hypersonic cruise missiles (Figure 6).⁷⁰

Figure 6: Hu Xiaoxiang



Hu wrote five papers with his supervisor at the University of Agder, all of which listed the Xi’an Research Institute as his affiliation. The papers focused on air-breathing hypersonic vehicles, which travel at over five times the speed of sound and ‘can carry more payload than ordinary flight vehicles’.⁷¹ Hu’s work was supported by a Norwegian Government grant for offshore wind energy research.⁷²

Besides his affiliation with the Xi’an Research Institute, there’s a large body of evidence tying Hu to RFEU. The website of RFEU’s missile research centre states that Hu Xiaoxiang won an award in 2014 for his PhD thesis on hypersonic aircraft, supervised by General Hu Changhua.⁷³ The website also says that in 2014 he received 250,000 renminbi (A\$50,000) from the Chinese Government for a three-year research project on hypersonic aircraft (Figure 7).⁷⁴ In 2016, he was described as a lecturer at the centre, which received 14 awards for missile research between 2010 and 2014.⁷⁵ In some publications, Hu also listed the Harbin Institute of Technology, a civilian university heavily engaged in military research, as a second affiliation.⁷⁶

Relations between China and Norway were put on ice when the Nobel Peace Prize was awarded to Chinese democracy activist Liu Xiaobo in 2010, and the Chinese Government was quick to attack Norway for Hu's expulsion.⁷⁷ Only in December 2016 did the two countries 'normalise' diplomatic relations. Public statements by Norwegian authorities didn't explain the Chinese scientist's military affiliation or mention the Xi'an Research Institute, as the information was likely classified.

Figure 7: A paper published by Hu Xiaoxiang shortly after his expulsion from Norway, stating an affiliation with RFEU in the Chinese version of the abstract but the Xi'an Research Institute in the English version

参数不确定高超声速飞行器自适应模糊 H_∞ 控制

王永超, 张胜修, 扈晓翔, 崔亚龙, 曹立佳
(第二炮兵工程大学, 西安 710025)

摘要: 针对具有参数不确定性特点的高超声速飞行器输出跟踪问题, 提出了一种自适应模糊 H_∞ 控制器设计方法。考虑系统存在的参数不确定性, 利用自适应模糊系统在线逼近动态逆控制器中的非线性项, 同时引入鲁棒补偿项, 减轻模糊系统逼近误差和系统外部干扰对控制系统稳定性造成的影响, 提高控制器的 H_∞ 性能。利用 Lyapunov 理论对整个系统的稳定性进行证明。对比仿真结果表明该方法能够保证高超声速飞行器具有良好的跟踪性能和很强的鲁棒性。

关键词: 高超声速飞行器; 模糊自适应控制; H_∞ 性能; 动态逆

中图分类号: TP273.2 文献标志码: A 文章编号: 1671-637X(2015)10-0024-06

Adaptive Fuzzy H_∞ Control for a Hypersonic Vehicle with Uncertainty Parameters

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A few months later, in September 2015, a court overturned the expulsions. Hu's lawyer stated after the trial that 'there is no evidence in the case that my client is part of research collaboration on missiles and weapons with China.'⁷⁸ The University of Agder lauded the decision as a win for academic freedom.

The Norwegian Government later successfully appealed the overturning of Hu's supervisor's expulsion. However, it's unclear whether any appeal was made in Hu's own case, which hasn't been made publicly available.⁷⁹ Neither the Xi'an Research Institute, Hu Changhua nor RFEU was mentioned in the judge's ruling on the German-Iranian supervisor's case or any coverage of the expulsions.

The Zhengzhou Institute of Surveying and Mapping

Among the 40 Chinese military scientists listed as presenting papers at the 9th International Symposium on Mobile Mapping Technology, nine claimed to be from an institution with no apparent military affiliation.⁸⁰ Most of the other 30 military scientists at the conference, hosted by UNSW in December 2015, were openly from NUDT and a research institute of China North Industries Group Corporation (also known as Norinco Group), China's largest arms manufacturer; the rest came mainly from the PLA Information Engineering University.

The nine claimed to be from the Zhengzhou Institute of Surveying and Mapping. This institute, which was officially known as the PLA Institute of Surveying and Mapping, no longer exists, having been subsumed in 1999 by PLAIEU—itself a major player in cyber operations and a key training ground for signals intelligence officers.⁸¹ The Zhengzhou Institute appears to live on as cover for PLA scientists interacting with foreigners. Nearly 300 peer-reviewed papers have been published by authors claiming to be from the institute.⁸²

The use of the Zhengzhou Institute of Surveying and Mapping as cover doesn't stop at international conferences. Numerous examples of visiting scholars claiming to be from there have been uncovered for this report. They include Zhu Xinhui (朱新慧), a lecturer at PLAIEU specialising in navigation technology, who visited UNSW from 2015 to 2016.⁸³ In numerous journal articles and in the program of the mobile mapping conference mentioned above, however, she is described as being from the Zhengzhou Institute of Surveying and Mapping.⁸⁴

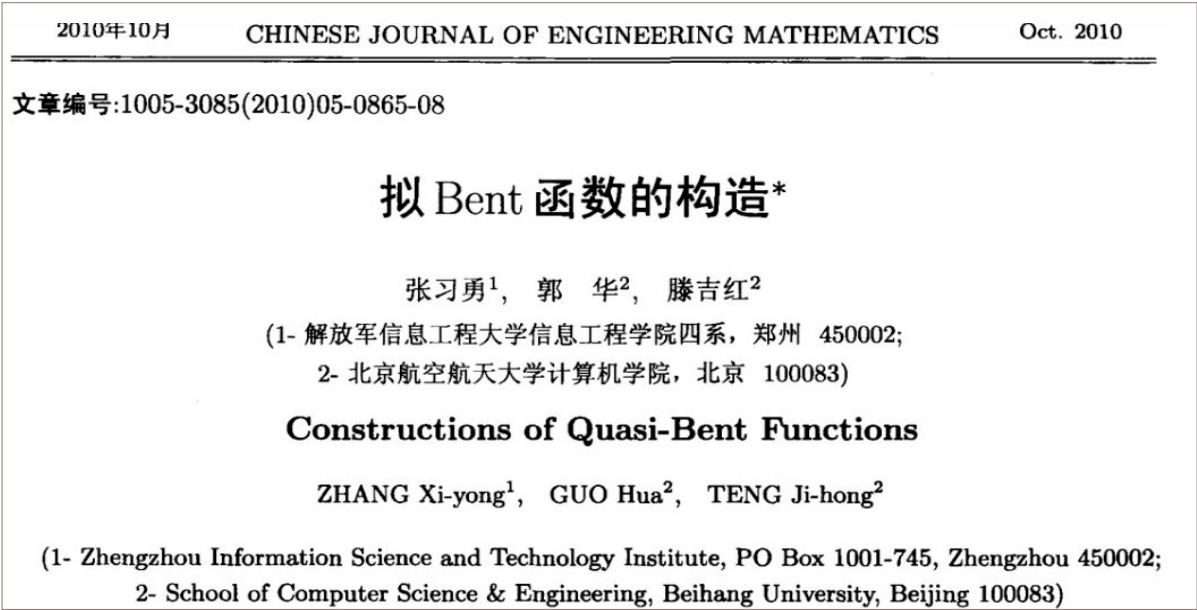
Guo Jianfeng (郭建锋), an associate professor at PLAIEU, visited Curtin University for a year in 2014. A specialist on navigation system data processing, Guo was described on the website of Curtin University's Global Navigation Satellite Systems Research Centre as being on 'sabbatical leave from the Department of Geodesy of the Institute of Surveying and Mapping, Zhengzhou, China'.⁸⁵

The Zhengzhou Information Science and Technology Institute

Another cover institute, the Zhengzhou Information Science and Technology Institute (ZISTI), which appears to exist only on paper, has also been widely used by PLAIEU scientists to publish research and travel overseas. More than 1,300 pieces of peer-reviewed literature have been authored by individuals claiming to be from ZISTI.⁸⁶

One paper in a Chinese-language journal by a PLAIEU researcher, which includes an English version of the abstract and author information, clearly shows that ZISTI is a cover institute (Figure 8). The paper's Chinese text describes the first author as affiliated with PLAIEU, but the English version describes the same author as affiliated with ZISTI.⁸⁷ Nearly all of the authors sampled who claimed an affiliation with ZISTI could be shown to be working at PLAIEU.

Figure 8: Chinese and English versions of a paper published by a PLAIEU scientist, demonstrating the use of the Zhengzhou Information Science and Technology Institute as cover



Scientists claiming to be from ZISTI have attended international conferences both inside and outside China. For example, seven researchers affiliated with ZISTI are listed in the program of a conference on signal processing at the Gold Coast in Australia in 2014. Experts from American, Australian and Korean defence research agencies were also in attendance.⁸⁸

As with the Zhengzhou Institute of Surveying and Mapping, ZISTI has been used as cover for PLA scientists travelling overseas as visiting scholars. For example, Zhu Yijun (朱义君) is an associate professor at PLAIEU specialising in signals engineering.⁸⁹ Claiming to be from ZISTI, in 2011 he visited Canada's McMaster University, where he worked on wireless communications technology with wide-ranging military applications.⁹⁰

PLAIEU scientists claiming to be from ZISTI have also travelled to the US as visiting scholars and for conferences.⁹¹

Espionage and intellectual property theft

In addition to their overt activities, PLA researchers, especially those who haven't been forthcoming about their military affiliations, may engage in espionage or steal intellectual property while overseas. The PLA engages in such high levels of espionage that in 2014 the US Government took the unusual step of publicly indicting five Chinese military hackers.⁹² Military scientists abroad who regularly communicate with superiors in China, receive visits by superiors while overseas and return home in the middle of their time abroad for 'remedial education', as described in the examples outlined above, offer safe and convenient channels for Chinese intelligence agencies to access sensitive information from overseas.⁹³

Amateur collectors with STEM expertise have been implicated in a high proportion of intellectual property theft and espionage cases involving China.⁹⁴ Scientists and engineers involved in military research projects, while they might not have received formal training as spies, are uniquely qualified to identify and exfiltrate valuable information to overcome specific hurdles in the development of new technologies.

Should universities collaborate with the PLA?

Assessing the costs and benefits of research collaboration with the PLA shows that it comes with significant security risks while offering unclear benefits. It isn't in the national interest of most of the countries examined in this report to help build the capabilities of a rival military. Other forms of cooperation with the Chinese military, such as joint exercises and exchanges that build understanding and communication, are largely beneficial but distinct from the kinds of research collaboration addressed in this report.

The benefits of research collaboration with the Chinese military are difficult to measure, but could include the following:

- Training PLA scientists and working with them leads to scientific developments and published research while attracting some funding.
- A small proportion of collaboration with the PLA appears sufficiently transparent and falls into areas of fundamental research such that the benefits may outweigh security risks. One possible example is cooperation between the American and Chinese governments on the multinational Daya Bay Reactor Neutrino Experiment, which involves NUDT.

A number of benefits usually associated with research collaboration with militaries and foreign countries haven't been observed in PLA collaboration:

- PLA collaboration doesn't lead to long-term improvement in the talent of institutions and countries accepting PLA scientists, as the PLA claims that *100 per cent* of scientists sent abroad by NUDT in the years before 2013 returned to China on time.⁹⁵
- The forms of PLA collaboration studied in this report don't promote understanding and relationships between militaries, as they aren't military exchanges and often aren't overt.
- While overseas, PLA scientists remain under the close watch of the CCP, which works to ensure that they remain loyal and aren't influenced by their experience living in free societies.
- It's improbable that PLA scientists working with overseas civilian researchers would share with or disclose to those researchers any significant research breakthroughs of military value.

There are many risks and costs associated with current approaches to training and collaborating with PLA scientists:

- Training PLA scientists improves the scientific talent and knowledge of a military treated by many as a strategic competitor.⁹⁶
- PLA scientists often engage in deception in their interactions with foreign institutions and their staff, making it difficult for those collaborating with them to take appropriate security precautions.
- PLA scientists could gather intelligence and steal technology while they're overseas, especially if they're hiding their military affiliations.
- Failures to address concerns about PLA collaboration and to develop policies differentiating it from wider engagement with China risk tarring all research ties with China with the same brush.
- Research collaboration with the PLA contributes to technology that may be used against Australia and its partners in a conflict or for intelligence collection.
- Universities with ties to the PLA risk eroding trust between themselves and funders of research, such as defence research agencies, scientific agencies and industry.
- Universities risk reputational damage by collaborating with a non-allied military.
- Public funding worth millions of dollars is being used for collaboration with a non-allied military, with little to no input from taxpayers.



Current policy and legislation are inadequate

Export controls are the primary mechanism by which countries seek to manage the supply of sensitive technology and goods to overseas entities. However, the ability of export control laws to effectively manage the risks posed by PLA research collaboration is limited. In Australia, few cases of research or cooperation contrary to our national interests are believed to have been prevented through the *Defence Trade Controls Act 2012*.⁹⁷ The current review of the Act offers an opportunity to address some of these limitations.

There are a few reasons for these difficulties. First, intangible transfer of technology—the primary form of technology transfer taking place through the kinds of collaboration studied in this paper—is extremely difficult to control in practice because it doesn't involve the export of physical goods.⁹⁸ Second, the Act doesn't regulate the supply of controlled technology, which includes instruction and training, to individuals in Australia even if they're PLA members. Third, some of this collaboration covers emerging technologies, such as quantum physics, that are important but not included in the Defence and Strategic Goods List, as their applications aren't yet fully known. Export control lists tend to be slow to incorporate emerging technologies, so regulatory power can come well after issues become apparent. Fourth, the Act doesn't regulate the supply of controlled technology by Australians when they're outside of Australia, such as training given to PLA members by Australian academics visiting China.

Recommendations

The PLA's collaboration with foreign universities is growing and the expansion of international ties remains one of NUDT's priorities.⁹⁹ The developments outlined in this report warrant more attention and different approaches from those currently employed by most governments and universities. Responses to PLA collaboration need to be informed by clear government policies and move beyond export controls, using the full range of tools available to governments and universities. The Australian Government, for example, can do more to work in partnership with our research sector to advance scientific progress while protecting national security and ensuring that relevant research doesn't advance the Chinese military's capabilities.

Based on the findings of this report, it is recommended that governments pursue the following measures:

Deepen discussions within government on PLA collaboration to determine how it relates to the national interest

- Determine what kinds of collaboration with the PLA should be further controlled or even prohibited and establish clear policy on engagement with PLA research organisations and personnel.
- Foster international discussions on PLA collaboration to develop multilateral responses.
- Develop interagency responses to PLA collaboration to ensure better integration of efforts by defence and export control agencies, intelligence agencies and immigration agencies.
- Share information about cases and trends in PLA collaboration, particularly cases of deception by PLA scientists, with partners across the globe.

Increase communication and outreach to universities, companies and publics

- Establish a committee bringing together members of the national security community and university leaders. This committee could serve as a forum to share key information and foster a more cooperative working environment while also providing a space for the university sector and national security community to better understand each other's perspectives. The US Federal Bureau of Investigation's National Security Higher Education Advisory Board is a useful model to emulate.¹⁰⁰
- Ensure that companies funding research at universities are aware of any PLA collaboration and understand future measures to control such collaboration.
- Politicians and senior public servants should better articulate what's in the national interest and publicly explain why advancing China's military capabilities isn't in the national interest.¹⁰¹

Improve the scrutiny of visa applications by foreign military personnel

- Enhance and better coordinate efforts by government agencies such as Australia's Department of Home Affairs, Department of Defence and Australian Security Intelligence Organisation to ensure that military scientists applying for visas are identified and properly vetted.¹⁰²
- Create a list of Chinese and other non-allied military and military-linked research institutions, including civilian universities heavily engaged in military research, for use by immigration officials.

Re-examine export controls

- The Australian Government should consider further controlling technology transfer to certain end users. Transfers of controlled technology to PLA members and civilians heavily engaged in military research should be restricted regardless of their geographical location.
- The Australian Government should create a list of entities posing national security risks that are subject to special export licence requirements, modelled on the US's Entity List.
- The government should help universities train and provide resources for staff with export control compliance duties.
- Work continuously with experienced scientists in emerging technology fields to determine whether and how emerging technologies should be controlled.
- Ensure that universities are fully complying with controls relating to the intangible transfer of technology in their collaboration with the PLA.

Regulate scientific training given to foreign military personnel

- Introduce legislation that draws on the US Code of Federal Regulations' rules on defence services, which require those offering training to foreign military personnel to first receive a waiver from the US Department of Defense.¹⁰³ This could take the form of an expansion of the Defence Trade Controls Act that restricts technology transfer to members of certain governments and organisations.



Regulate the use of government resources in collaboration with the Chinese military and other non-allied militaries

- Update internal policies in government research institutions such as CSIRO to limit or ban collaboration with non-allied militaries, particularly in dual-use areas.
- Funding bodies such as the Australian Research Council should prohibit funding in some areas from being used in collaboration with non-allied militaries.
- Carefully evaluate any collaboration with PLA scientists on government-funded projects, particularly defence projects.

Increase government and other funding for research in strategic research areas

- Fields such as artificial intelligence and quantum physics should receive more government funding to ensure that talent and ideas stay in Australia.
- Universities working in strategic research areas should be encouraged to collaborate with allied military and defence countries rather than non-allied militaries.

Limit problematic forms of foreign investment in strategic research areas

- Investment by Chinese defence companies such as China Electronics Technology Group Corporation into strategically important fields should be prohibited.¹⁰⁴

Universities should also pursue the following measures:

Build understanding of PLA collaboration

- Produce credible and thorough assessments of the extent of PLA collaboration on campuses.
- Develop processes for managing PLA collaboration so that security risks can be identified and resolved

Raise awareness among employees

- Ensure that those interacting with members of non-allied militaries take appropriate security precautions.

Exercise greater oversight of visiting scholar and student application

Develop internal policies on collaboration with foreign military personnel

- Require employees to receive approval before collaborating with or training members of non-allied militaries.

Notes

- 1 This estimate has sought to exclude PLA medical scientists and doctors by not counting those affiliated with PLA medical institutions. Media reports, many of which are cited in this report, were one important source for determining the number of PLA scientists sent abroad. Feng Chunmei 冯春梅, Cai Weibin 蔡渭滨, Li Zhi 李治, 'Guofang keji daxue shixiang weilai zhanzheng de rencai hangmu' 国防科技大学驶向未来战争的人才航母 [NUDT—An aircraft carrier of talent steering towards future wars], *Renmin Ribao* 人民日报, 8 August 2013, [online](#), claims that NUDT had sent 1,600 scientists overseas as students or visiting scholars 'in recent years'. Assuming the 1,600 figure describes the number of NUDT scientists sent abroad between 2007, when the PLA substantially increased the number of scientists it sent overseas, and 2013, this gives roughly 230 NUDT scientists sent overseas each year. Conservatively, this indicates that well over 2,000 NUDT scientists have been sent abroad since 2007. Accounting for the fact that NUDT is responsible for approximately 80% of publications written by PLA scientists with overseas scientists and assuming that represents the proportion of PLA scientists overseas who are from NUDT, this means that more than 2,500 PLA scientists have been sent overseas since 2007. This estimate was also supported by a second set of open-source data which, to prevent the information from being removed, has not been revealed.
- 2 New Zealand is not counted here, despite being a Five Eyes country. It has high levels of PLA collaboration, especially relative to its population, but is not among the top countries for collaboration more generally.
- 3 C Uhlmann, 'China an "extreme" threat to Australia: ASIO', *9 News*, 31 January 2018, [online](#); Bill Gertz, 'FBI director warns China is America's most significant intelligence threat', *The Washington Free Beacon*, 19 July 2018, [online](#); 'German intelligence unmasking alleged covert Chinese social media profiles', *Reuters*, 10 December 2017. For a discussion of the case of Huang Jing in Singapore, see John Garnaut, 'Australia's China reset', *The Monthly*, August 2018.
- 4 Wang Wowen 王握文, 'Zouchu guomen, dang zuzhi shenghuo "bu diaoxian", 走出国门·党组织生活不掉线' [Exiting the country, they stay connected with the life of party organisations], *Jiefangjunbao* 解放军报, 1 July 2015, [online](#).
- 5 One of the only papers to address research collaboration with the PLA is Elsa Kania, *Technological entanglement*, ASPI, Canberra, 28 June 2018, [online](#).
- 6 Section 1286 of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 offers an important starting point for policies on scientific engagement with China and the PLA, seeking to protect scientists from undue foreign influence, safeguard important information and support the growth of domestic talent.
- 7 Richard Holt, *AAAS statement on White House proclamation on immigration and visas*, American Association for the Advancement of Science, 25 September 2017, [online](#).
- 8 See Yangyang Cheng, 'The future of particle physics will live and die in China', *Foreign Policy*, 2 November 2017, [online](#), for an eye-opening discussion of the level of political involvement in China's scientific research, even research into particle physics.
- 9 DJ Howard, FN Laird, 'The new normal in funding university science', *Issues in Science and Technology*, 2013, 30(1), [online](#); M Clarke, 'Federal government university budget leaves 10,000 places unfunded, Universities Australia says', *ABC News*, 18 January 2018, [online](#); N Whigham, 'Medical and scientific research at a crossroads in Australia as funding stagnates', *News.com.au*, 7 November 2016, [online](#).
- 10 UNSW, for example, has partnered with the Chinese Government's Torch Program, attracting tens of millions of dollars in R&D funding from Chinese companies. See 'UNSW celebrates first anniversary of Torch partnership with China', *UNSW Media*, 28 March 2017, [online](#).
- 11 It appears that most of those sent abroad are PLA 'civilian cadres' (文职干部), rather than ranking military officers. While they're counted as members of the PLA, civilian cadres aren't combat personnel and often work in technical areas, such as scientific research. See information about civilian cadres at [Chinamil.com.cn](#).
- 12 Peer-reviewed literature is the most accessible but not the only measure of PLA collaboration. Other facets of PLA collaboration include visiting and lecturing at PLA institutions, supervising PLA students and visiting scholars, which are correlated with but distinct from the level of peer-reviewed literature. Findings on peer-reviewed literature by PLA scientists with foreign researchers are based on searches in Scopus, the largest database of peer-reviewed literature, covering 16 PLA institutions and aliases. Hong Kong wasn't counted together with the PRC mainland. Note that publications by PLA scientists from medical institutions have been excluded. The following institutions and aliases were included in the search: National University of Defense Technology, National Key Laboratory for Parallel and Distributed Processing, PLA University of Science and Technology, PLA Information Engineering University, Zhengzhou Information Science and Technology Institute, Zhengzhou Institute of Surveying and Mapping, Air Force Engineering University, Second Artillery Engineering College, Xi'an Research Institute of High Technology, Academy of Armored Force Engineering, Academy of Equipment Command and Technology, National Digital Switching System Engineering and Technological Research Center, Northwest Institute of Nuclear Technology, China Aerodynamics Research and Development Center, Naval University of Engineering and PLA Electronic Engineering Institute.
- 13 See the section on international ties, which discusses sending students abroad and building academic ties separately from military exchanges, in Liu Hang (ed.), *2015 National University of Defence Technology admissions guide*, [online](#).
- 14 The Army Engineering University was formed in August 2017 through the merger of the PLA University of Science and Technology and a number of other army colleges. See Anonymous, 'Lujun gongcheng daxue jiepai, you gongchengbing xueyuan deng 5 suo yuanxiao heping zujian' 陆军工程大学揭牌·由工程兵学院等5所院校合并组建 [The Army Engineering University is unveiled, formed by the merger of the Engineering College and five other institutions], *Pengpai* 澎湃, 3 August 2017, [online](#).
- 15 Brian Boyle, 'Chinese partnerships are vital for universities and global research', *Financial Review*, 29 October 2017, [online](#).
- 16 Clive Hamilton, Alex Joske, 'Australian universities are helping China's military surpass the United States', *Sydney Morning Herald*, 24 October 2017, [online](#).
- 17 Clive Hamilton, *Silent Invasion*, Hardy Grant Books, 2018, 190–193.
- 18 Hamilton & Joske, 'Australian universities are helping China's military surpass the United States'.
- 19 Mengjian Zhu, Moshe Ben Shalom, Artem Mishchenko, Vladimir Falko, Kostya Novoselov, Andre Geim, 'Supercurrent and multiple Andreev reflections in micrometer-long ballistic graphene Josephson junctions', *Nanoscale*, 2018, issue 6, [online](#).
- 20 Wang Wowen 王握文, 'Zouchu guomen, dang zuzhi shenghuo "bu diaoxian", 走出国门·党组织生活不掉线' [Exiting the country, they stay connected with the life of party organisations].

- 21 Greg Levesque, Mark Stokes, *Blurred lines: military–civil fusion and the ‘going out’ of China’s defense industry*, Pointe Bello, December 2016, [online](#).
- 22 Zhou Xin (ed.), ‘Xi calls for deepened military–civilian integration’, *Xinhuanet*, 12 March 2018, [online](#); Lorand Laskai, ‘Civil–military fusion and the PLA’s pursuit of dominance in emerging technologies’, *China Brief*, Jamestown Foundation, 9 April 2018, [online](#).
- 23 Yu Yang 杨宇, ‘Guojia gongpai liuxue xinmoshi’ 国家公派留学新模式 [A new model of government-sponsored overseas study], *Shenzhou xueren* 神州学人, 2017, 9:14–17, [online](#).
- 24 Wang Wowen 王握文, Jia Chaoping 贾朝星, ‘Ba “nan chucai” de jichu yanjiu zuo jingcai, Zhang Chaofan de “bu pingfan zhi lu” 把“难出彩”的基础研究做精彩·张超凡的“不平凡之路” [Bringing out the colour of fundamental research—the extraordinary story of Zhang Chaofan], *xy.nudt.edu.cn*, 10 June 2017, [online](#).
- 25 Feng et al., ‘Guofang keji daxue shixiang weilai zhanzheng de rencai hangmu’ 国防科技大学 驶向未来战争的人才航母 [NUDT—An aircraft carrier of talent steering towards future wars]. NUDT admitted roughly 260 military PhD scholars in 2016, sending around 100 PhD scholars to study overseas in the same year. This indicates that roughly 40% of PhD scholars spend time overseas as part of their studies. Similar figures apply for other years, [online](#). Wang Wowen 王握文, ‘Zouchu guomen, dang zuzhi shenghuo “bu diaoxian”’, also claims that 26% of teachers at one of NUDT’s colleges spent time studying abroad.
- 26 Yang Jungang 杨俊刚, Li Jun 李骏, An Wei 安玮, ‘Guoji lianhe peiyang boshi yanjiusheng moshi tansuo’ 国际联合培养博士研究生模式探索 [An exploration of models of international joint training of doctoral students], *Zhongguo Kexue Zongheng* 中国科学纵横, 2016, 8:255–256.
- 27 Zhong Hua 钟华, ‘Yang Xuejun yuanshi: junmin ronghe shixian jundui daxue de kaifangxing’, 杨学军院士：军民融合实现军队大学的开放性 [Academician Yang Xuejun: military–civil fusion is the realisation of the openness of military universities], *Zhongguo kexuebao* 中国科学报, 24 October 2012.
- 28 James Mulvenon, Bates Gill, ‘Chinese military-related think tanks and research institutions’, *The China Quarterly*, September 2002, 171:622–623.
- 29 Hamilton & Joske, ‘Australian universities are helping China’s military surpass the United States’.
- 30 US Government, ‘Addition of certain persons to the entity list; and removal of person from the entity list based on a removal request’, *Federal Register*, 18 February 2015, [online](#).
- 31 Yang Jungang 杨俊刚, Li Jun 李骏, An Wei 安玮, ‘Guoji lianhe peiyang boshi yanjiusheng moshi tansuo’ 国际联合培养博士研究生模式探索 [An exploration of models of international joint training of doctoral students].
- 32 The cases of Guan Naiyang and Chang Lei, discussed in Hamilton & Joske, ‘Australian universities are helping China’s military surpass the United States’.
- 33 For example, the Chinese Academy of Sciences was used as cover by PLA anti-satellite weaponry expert Yu Xiaohong to travel to the University of Michigan. For further information, see Daniel Golden, *Spy schools: how the CIA, FBI, and foreign intelligence agencies secretly exploit America’s universities*, Henry Holt and Company, New York, 2017, 36.
- 34 Given that an estimated 2,500 PLA scientists have been sent abroad since 2007, that figure can be weighted using the proportion of peer-reviewed literature co-authored by scientists from each country with PLA researchers. For example, roughly 21% of papers co-authored by PLA scientists and overseas scientists between 2007 and 2017 include a UK-based scientist as an author. Multiplying 0.21 (the estimated proportion of PLA scientists sent to the UK) by 2,500 (the median estimate of the number of PLA scientists sent abroad) gives 525 PLA scientists sent to the UK since 2007. Note that one major shortcoming of this methodology is that publications may be counted twice if they include authors from China and two other countries.
- 35 Notably, no American institution was among these universities, despite the US being one of the primary destinations for PLA scientists. This may indicate that PLA collaboration in American universities is spread more broadly between institutions, rather than being concentrated in a handful. It may also be a reflection of the limitations of relying on collaboration on peer-reviewed literature as a measure of PLA collaboration.
- 36 Liu Hang 刘航, ‘2015 nian guofang kexue jishu daxue zhaosheng jianzhang’ 2015 年国防科学技术大学招生简章 [2015 NUDT student recruitment guide], *Zhongguo Junwang* 中国军网, 13 May 2015, [online](#).
- 37 Kai Bongs, Leonard J Pietrafosa, Xue Jingling and Tao Dacheng, as named in *NUDT 2018 doctoral student recruitment guide*, NUDT, August 2017, [online](#). New Zealand Scientist Gao Wei (高维) was also listed as an NUDT supervisor in 2017.
- 38 Yang Yu 杨宇, ‘Guojia gongpai liuxue xin moshi’ 国家公派留学新模式 [A new model of government-sponsored overseas study], *Shenzhou Xueren* 神州学人, 2017, 9:14–17, [online](#).
- 39 Feng et al., ‘Guofang keji daxue shixiang weilai zhanzheng de rencai hangmu’ 国防科技大学 驶向未来战争的人才航母 [NUDT—An aircraft carrier of talent steering towards future wars].
- 40 ‘MoU with China’, media release, Massey University, New Zealand, 19 May 2008, [online](#).
- 41 Wang 王握文, ‘Zouchu guomen, dang zuzhi shenghuo “bu diaoxian”’, 走出国门·党组织生活‘不掉线’ [Exiting the country, they stay connected with the life of party organisations].
- 42 Wang 王握文, ‘Zouchu guomen, dang zuzhi shenghuo “bu diaoxian”’, 走出国门·党组织生活‘不掉线’ [Exiting the country, they stay connected with the life of party organisations].
- 43 Zhong 钟华, ‘Yang Xuejun yuanshi: junmin ronghe shixian jundui daxue de kaifangxing’, 杨学军院士：军民融合实现军队大学的开放性 [Academician Yang Xuejun: military–civil fusion is the realisation of the openness of military universities].
- 44 Zhong 钟华, ‘Yang Xuejun yuanshi: junmin ronghe shixian jundui daxue de kaifangxing’, 杨学军院士：军民融合实现军队大学的开放性 [Academician Yang Xuejun: military–civil fusion is the realisation of the openness of military universities].
- 45 Zhong 钟华, ‘Yang Xuejun yuanshi: junmin ronghe shixian jundui daxue de kaifangxing’, 杨学军院士：军民融合实现军队大学的开放性 [Academician Yang Xuejun: military–civil fusion is the realisation of the openness of military universities].
- 46 Zhong 钟华, ‘Yang Xuejun yuanshi: junmin ronghe shixian jundui daxue de kaifangxing’, 杨学军院士：军民融合实现军队大学的开放性 [Academician Yang Xuejun: military–civil fusion is the realisation of the openness of military universities].
- 47 Wang Wowen 王握文, ‘Guofang keda haiwai jian 8 ge dang zhibu liuxuesheng quanbu wei dangyuan’ 国防科大海外建8个党支部 留学生全部为党员 [NUDT has established 8 overseas party branches, all overseas students are party members], *Jiefangjun Bao* 解放军报, 21 January 2013 [online](#).

- 48 Feng Chunmei 冯春梅, Cai Weibin 蔡渭滨, Li Zhi 李治, 'Guofang keda dazao xinxing junshi rencai 10 nian taotai 152 ming boshisheng' 国防科大打造新型军事人才 10 年淘汰 152 名博士生 [NUDT creating a new model of military talent, weeds out 152 doctoral students in ten years], *Renminwang* 人民网, 9 October 2013, [online](#).
- 49 Wang 王握文, 'Zouchu guomen, dang zuzhi shenghuo "bu diaoxian" 走出国门·党组织生活不掉线' [Exiting the country, they stay connected with the life of party organisations].
- 50 Wang Wowen 王握文, Chen Ming 陈明, 'Guofang keda haiwai liuxuesheng tongbu xuexi dang de shijijuda baogao' 国防科大海外留学生同步学习党的十九大报告 [Overseas NUDT students study the 19th Party Congress report], *Huasheng Zaixian* 华声在线, 20 October 2017, [online](#).
- 51 Bethany Allen-Ebrahimian, 'The Chinese Communist Party is setting up cells at universities across America', *Foreign Policy*, 18 April 2018, [online](#).
- 52 Yang Yanqing 杨彦青, Xie Qi 谢琦, "'Weixin qun" zhuli haiwai xuezi jiangding xinnian' 微信群"助理海外学子坚定信念 [WeChat groups help overseas students stick firmly to their faith], *Guangming Ribao* 光明日报, 19 November 2015, [online](#).
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- 54 *2015 graduate study abroad policy*, National University of Defense Technology, 18 November 2014, [online](#).
- 55 Anonymous, 'Guofang keda jinnian zhichi 600 duo ren chuguo shenzao 100% anshi huiguo' 国防科大近年支持 600 多人出国深造 100% 按时回国 [NUDT sent over 600 overseas for development in recent years—100 per cent returned on time], *Jiefangjunbao* 解放军报, 27 August 2013, [online](#).
- 56 'Will military school graduation affect visas?', [www.chuguo.cn](#), 23 May 2002, [online](#).
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- 59 Matt Nippert, 'OIA documents confirm National MP Jian Yang did not disclose military intelligence links', *NZ Herald*, 19 October 2017, [online](#); Li Jingwei, 'Do everything you do; chances come to you', *GP Global People*, 2013, [online](#); Alex Joske, 'Incident at university pharmacy highlights a divided Chinese community', *Woroni*, 26 August 2016, [online](#). Yang Jiang's PhD thesis is available [online](#).
- 60 Jennings & Sachdeva, 'Papers shed light on Yang's past'
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Acronyms and abbreviations

CCP	Chinese Communist Party
CSIRO	Commonwealth Scientific and Industrial Research Organisation
NUDT	National University of Defense Technology
PLA	People's Liberation Army
PLAIEU	PLA Information Engineering University
RFEU	Rocket Force Engineering University
STEM	science, technology, engineering and mathematics
UNSW	University of New South Wales
ZISTI	Zhengzhou Information Science and Technology Institute



