2025
innovations dialogue.
Neurotechnologies and their implications for international peace and security

NEURO RISK IMPACT ASSESSMENT (NRIA):
Integrating Neurotech Ethics into Military Strategic Planning Frameworks

Naveen Kumar Samuel Kori, Public Policy Specialist
E-mail: naveenkori.peace@gmail.com

Image: © Unknown Author, CC BY-NC-SA

What is NRIA?

A **novel governance concept**: a structured pre-deployment framework inspired by Environmental and Social Impact Assessment practices (UNEP, 2009; MoEFCC, 2023).

What it does?

It embeds **ethical, legal, and societal** review across the concept, design, testing, and fielding cycles of military neurotechnologies.

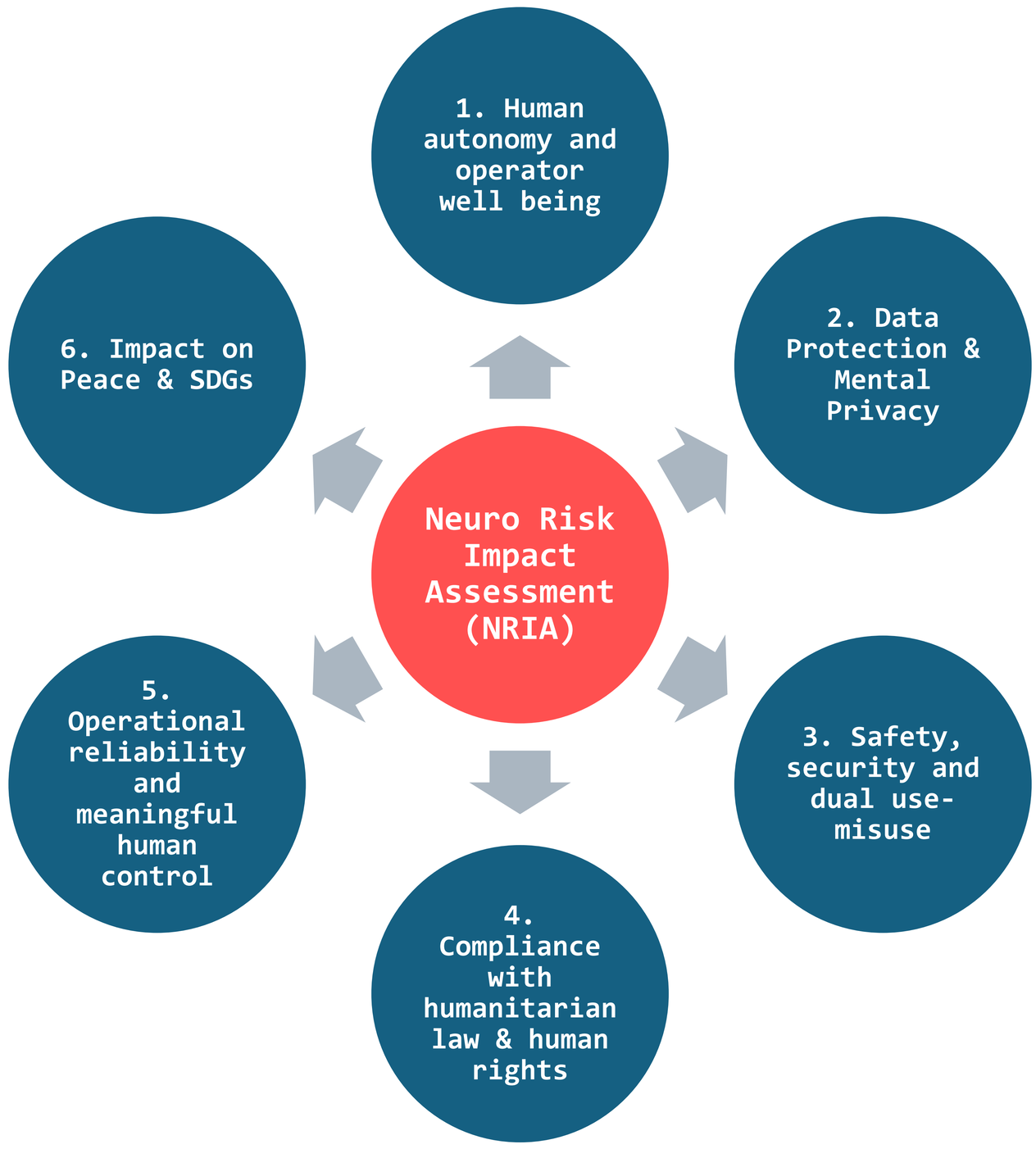
Why NRIA?

1. Neurotechnologies are entering defence operations faster than ethical oversight can adapt, raising **risks to autonomy, privacy, and humanitarian law.**

2. NRIA establishes clear ethical boundaries and accountability to **protect human rights rather than to legitimise neuro-military innovation.**

3. **Governance gaps persist:** since its adoption in 2019, 39 countries have adhered to the **OECD Neurotechnology Recommendation**, yet few reference ethical safeguards in defence R&D, even as programmes like DARPA's N3 and China's brain–machine interface research advance without shared standards.

Figure 1. *Six assessment dimensions of NRIA*



Note. Conceptualised by Author

How it works?

Through a practical and auditable method that uses checklists, risk registers, mitigation plans, and oversight triggers to help defence planners, technologists, legal advisers, and ethicists align military neurotechnology with **responsible innovation, international humanitarian law, and peace and security objectives.**

Scan the QR Code for free access to the complete paper

Note: *The views and opinions expressed in this poster are solely those of the author, including any errors.*

UNIDIR

2025
innovations dialogue.

Neurotechnologies and their implications
for international peace and security

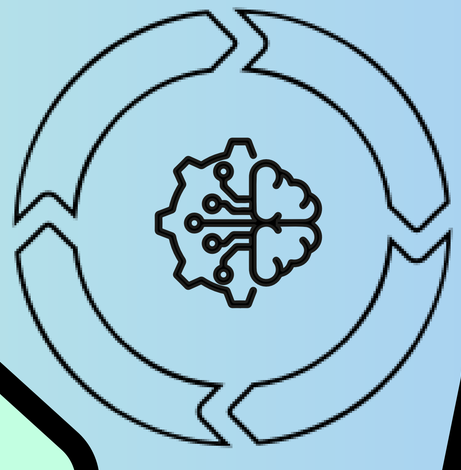
BRAIN AS BATTLESPACE
PERILS & PROSPECTS OF MILITARY NEUROTECHNOLOGIES

Safia Mansoor, PhD Scholar UOL, Pakistan

Neuroweapons Disrupt

Memory Morale Percept

Neural OODA loop = Speedy Cognitive cycle



Perils

- Mind-hacking
- Cognitive manipulation
- Loss of human privacy &autonomy
- Legal-ethical gaps

Cognitive Singularity of War

Inflection point
Human cognition + Neurotechnology integration
Brain as "decisive battlespace"

Prospects

- Medical spin-offs
- Enhanced soldier resilience
- Cognitive precision
- Neuro-driven autonomous systems
- Optimized decision making
- Deterrence by disruption.

NEURO

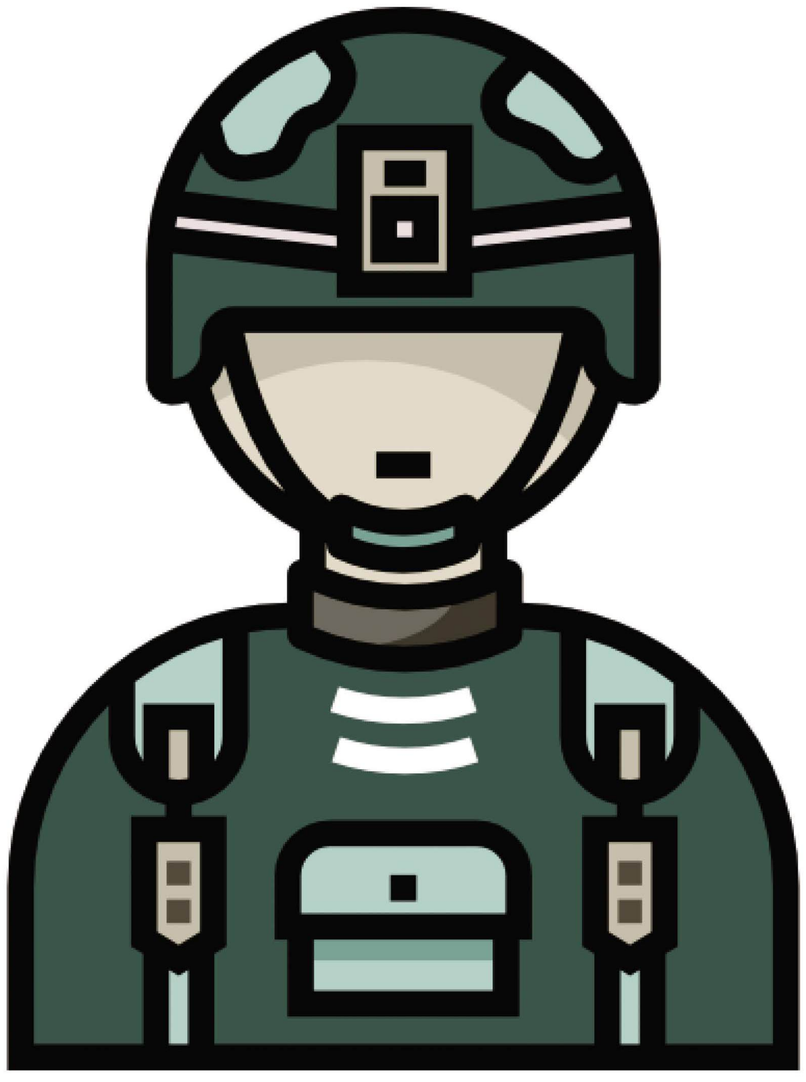
S	**Security**	Map neurodomain
E	***Ethics***	Neuro-norms , values
C	***Control***	Neuro-governance
U	***Use***	Transparent use
R	***Resilience***	Cognitive defense
E	***Enhancement***	Positive dual-use

UNIDIR

2025
innovations dialogue.

Neurotechnologies and their implications for international peace and security

Neuro-Rights Rules of Engagement: Embedding Mental Privacy in Military Neurotechnology



The Geneva Convention of the Mind

THE CHALLENGE: Brain-computer interfaces, neuro-enhancement drugs, and cognitive-data analytics enable involuntary access to soldiers' thoughts.

Traditional arms control is insufficient.

THE SOLUTION: Neuro-Rights Rules of Engagement (NR-RoE)

A three-layer framework integrating mental privacy, cognitive liberty, and neural-data protection with existing international humanitarian law.

Layer 1 – Ex-ante review:

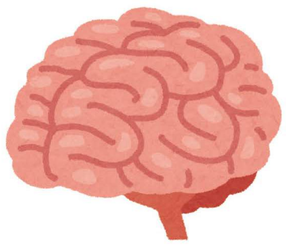
Every neuro-enabled system undergoes a Neuro-Rights Impact Assessment before procurement or deployment, paralleling chemical-weapon toxicology boards and ensuring that use-cases respect human dignity.

Layer 2 – Privacy-by-design architecture:

Mandatory on-device encryption, zero-knowledge authentication and automatic data-expiry protocols guarantee that neither commanders nor vendors can compel raw neural data, even under battlefield conditions.

Layer 3 – Independent oversight:

A UN-mandated Neuro-Ethics Inspectorate, operating under the Secretary-General's investigative authority, is empowered to verify compliance and investigate alleged misuse in conflict zones, providing credible, rapid accountability.



Jersain Llamas

By translating abstract human-rights language into concrete technical and procedural safeguards, NR-RoE offers states a practical pathway to harness operational advantages of neurotechnology while upholding the inviolability of the human mind.

UNIDIR

2025
innovations dialogue.

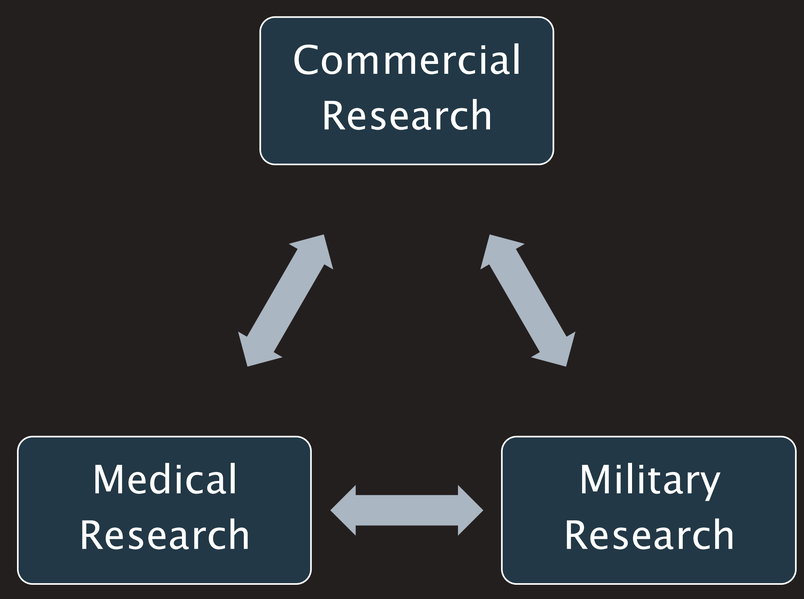
Neurotechnologies and their implications for international peace and security

Assessing the State of the Weaponization and Militarisation of Neurotechnologies

Tanya Gill & Matteo Drozynski

DUAL USE AND NEUROTECHNOLOGIES

Neurotechnologies are recently emerging technologies that are being developed across both private and public sectors. Given the scope and breadth of development, it is important to look at neurotechnology's 'dual use' functionality to truly understand the depth of the ongoing research. The term 'dual use' demonstrates that neurotechnologies often have both civilian and military functions. In other words, technologies used for medical purposes can also have commercial or military interests, or vice versa. The research done in civilian contexts can assist militaries to develop their own neurotechnology infrastructures.



NEUROTECHNOLOGY AND THE MILITARY

The rapid increase of both startups and big tech company interest in neurotechnology, combined with the use of AI, is rapidly advancing the consumption of direct-to-consumer neurotechnology devices that can be used in everyday scenarios by civilians. The diversity of available products and the ability to obtain copious amounts of data from users allow militaries to bypass much of the testing and data collection of technologies. For example, in April 2025, DARPA introduced their "RESTORE" program which will use advancements in non-invasive neuromodulation technologies and current civilian treatments for good sleep to optimize cognitive performance for warfighters with 3-hour sleep restrictions.

Military neurotechnology is still under development. Here are the major ways in which neurotechnology is used by militaries:

ENHANCEMENT OF WARFIGHTER CAPABILITIES

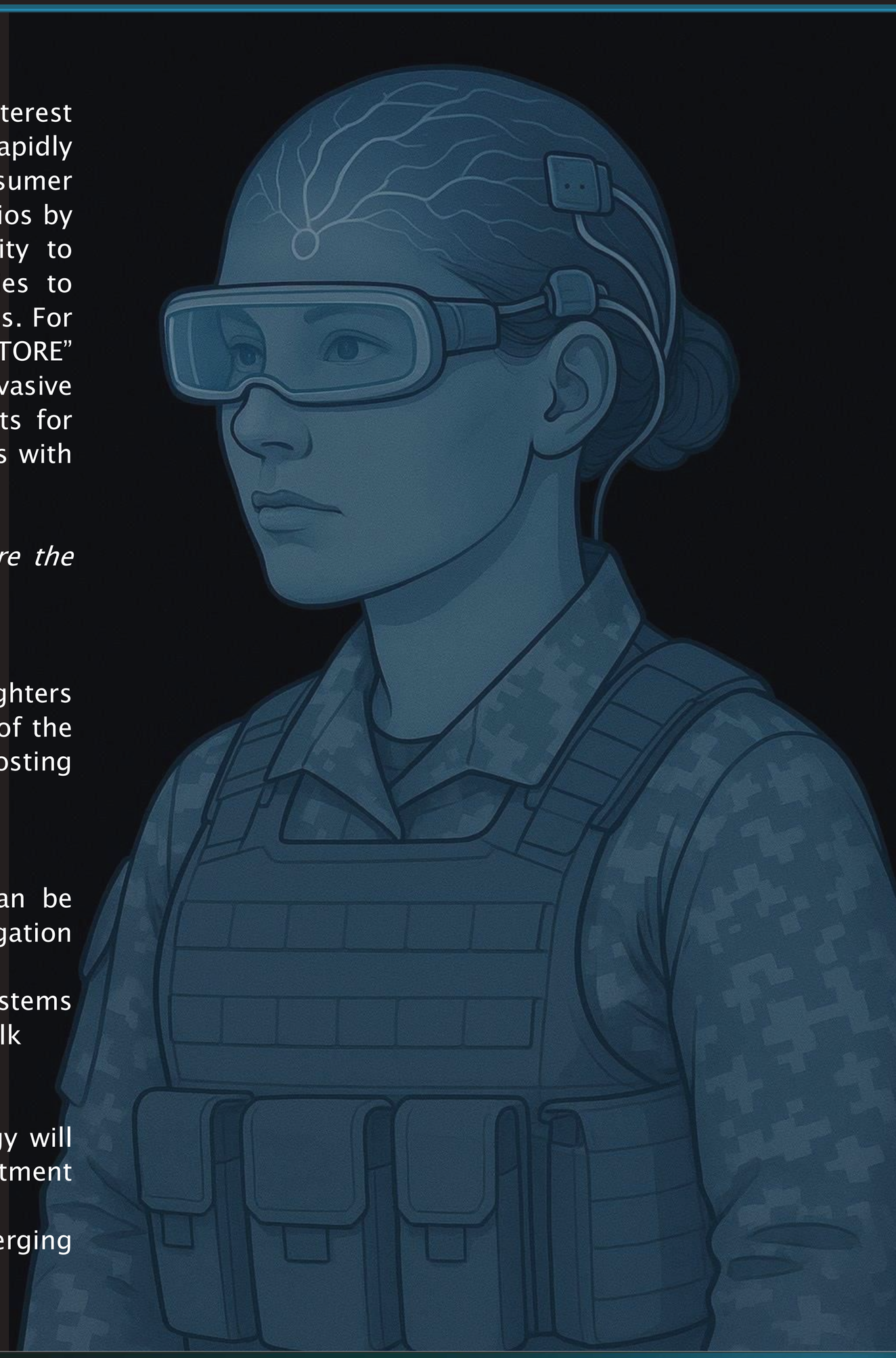
➔ Neurotechnologies dealing with enhancement of warfighters capabilities are meant to enhance the regular capabilities of the human body by creating novel attributes or by boosting functions over the normal range of performance.

DECEPTION DETECTION AND INTERROGATION

➔ State militaries are developing neurotechnologies that can be used to detect deception and assist with interrogation techniques.
➔ Ex. DARPA's Cognitive Technology Threat Warning Systems (CT2WS); DARPA's Advanced Speech Encoding and Silent Talk

TREATMENT AND REHABILITATION

➔ In the near-future, most realistic uses for neurotechnology will not be for offensive or attack purposes but rather for treatment of mental and physical ailments of combatants.
➔ Ex. DARPA Systems-Based Neurotechnology for Emerging Therapies (SUBNETS)



UNIDIR

2025
innovations dialogue.

Neurotechnologies and their implications for international peace and security

FROM CURE TO COMBAT:

Responsible Innovation in Neurotechnology

Cheya Took LL.M., T.M.C. Asser Instituut

INNOVATION

COMBAT
- Accuracy
- Superiority
- Speed
- Lethality

CURE
- Autonomy
- Function
- Recovery
- Dignity

START

1

SAFETY & SECURITY BY DESIGN:
Embedding Technical Safeguards in Neurotechnology from the Outset

\+ **PROACTIVE**

PRINCIPLED

DUAL-USE

BIOETHICS

2

TRANSPARENT GOVERNANCE:
Promoting Multi-Stakeholder Dialogue Across Science, Law & Security Domains

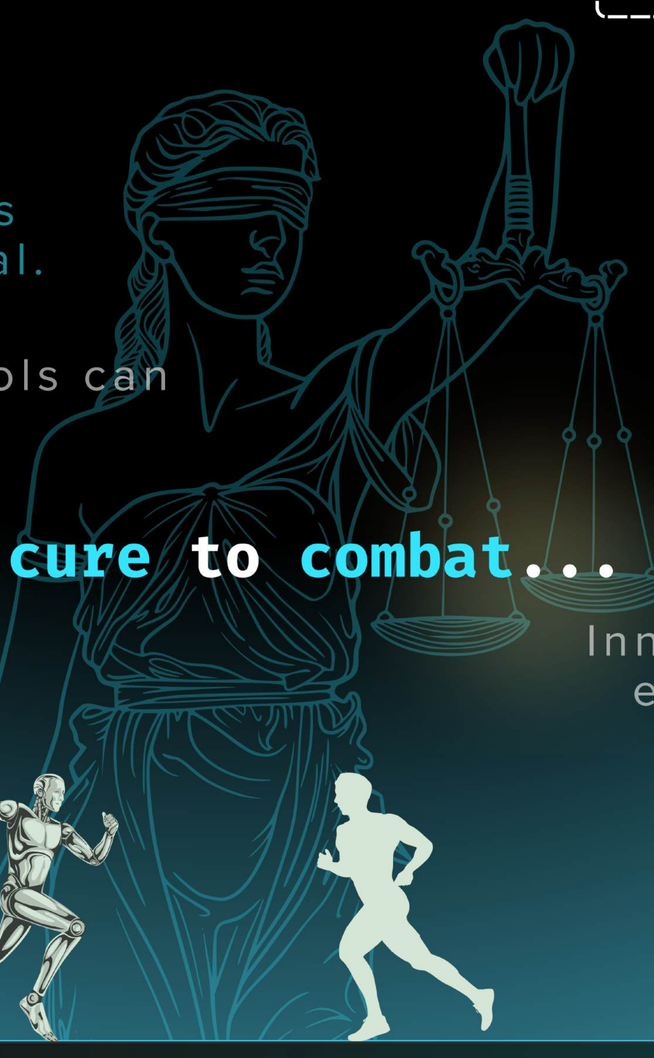
3

ETHICAL ALIGNMENT:
Ensuring Applications Remain Consistent with Human Rights & International Humanitarian Law

FINISH

Neurotechnology restored my father's movement, revealing its power to heal.

Yet we cannot forget how similar tools can be adapted for war.



From cure to combat...

Innovation's dual nature demands ethics, safety, and transparency to remain a force for peace.

#ID25

24 November 2025 • 09:00–17:45 CET • Geneva and online

UNIDIR.ORG

UNIDIR

2025 innovations dialogue.

Neurotechnologies and their implications for international peace and security

24 November 2025 • 09:00–17:45 CET • Geneva and online

#ID25
UNIDIR.ORG

Neurotechnology and the Challenge of Accountability in War

Niveditha Sasi Kumar

PROBLEM

The emergence of military neurotechnologies is generating new accountability gaps that warrant urgent scholarly and policy attention. The technological modification of cognition undermines the assumption that intent and action originate from an autonomous, unimpaired mind, thereby complicating legal assessments of mens rea and actus reus, which leads to uncertainty in attributing responsibility for unlawful acts in military contexts.

IMPLICATIONS & RISKS

- Gradual Erosion of Deterrence
- Institutional Unpreparedness
- Strategic Misuse by State or Non-State Actors to Evade Liability
- Violation of Emerging 'Cognitive Rights'
- Lack of Accountability and Subsequent Penal Action

The growing use of technologies that influence cognition complicates the attribution of responsibility and may eventually lead to diffused accountability, where multiple actors share partial liability for a crime.

Examples of Legal Stress Points

Domain	Examples	Gap
Domestic Law	United States Model Penal Code Substantial Capacity Test / Federal Mental Nonresponsibility Rule	Existing diminished capacity defenses do not have provisions for technologically induced impairment of the nervous system
International Law	Rome Statute (Article 28, Article 31)	Article 31: Refer to above cell Article 28: Commanders cannot reasonably and consistently predict the technologically altered behavior of their subordinates
Forensics	Absence of trace evidence	Extremely difficult to prove cognitive manipulation and loss of agency, and to attribute due responsibility of any crimes committed in war

Future Pathways & Priorities

- Developing forensic methods for detecting the past use of neurotechnology
- Establishing legal standards for technological diminished capacity
- Creating command liability frameworks when subordinate agency is technologically altered
- Defining evidentiary requirements for claims of cognitive manipulation
- Defining measurable thresholds for acceptable cognitive alteration in combat roles to prevent coercive or unsafe enhancement

UNIDIR

2025 innovations dialogue.

Neurotechnologies and their implications for international peace and security

24 November 2025 • 09:00–17:45 CET • Geneva and online

#ID25

UNIDIR.ORG

Mind-Controlled Robotics on the Battlefield: Responsible Use of Brain–Machine Interfaces

University of Technology Sydney Graphene EEG Sensors

Dry electrode technology enabling soldiers to control quadruped robots via neural signals without gel-based interfaces. Enables rapid deployment in field conditions.

Operational Benefits

3-5x faster response times, 40% reduced cognitive load, enhanced safety in CBRN environments, intuitive control with minimal training requirements.

Russian Research InitiativeNeuro Balalaika

Multi-signal interface recording EEG, EMG, and EOG simultaneously for hands-free operation of military exoskeletons and mobility systems.

Military Applications

Reconnaissance robotics, explosive ordnance disposal, tactical exoskeletons, unmanned vehicle control, battlefield casualty evacuation systems.

Critical Risks

Neural Data Exploitation: Unauthorized access to cognitive patterns and mental states

Cognitive Manipulation: Adversarial interference with decision-making

Autonomy Erosion: Compromised consent under pressure

Surveillance MisuseL: Unauthorized monitoring and data harvesting

Cyber Vulnerabilities: System compromise and signal interception

Privacy-by-Design

Hardware Security Tamper: resistant sensors, encrypted pathways

Data Protection: End-to-end encryption, minimal retention

Ethical Governance: Informed consent, transparency, oversight

Operational Resilience: Fail-safes, user overrides, adversarial testing

Legal Compliance: Neurorights protections, accountability

BMI Signal Processing Pipeline

1
Neural Capture
EEG sensors detect brain activity

2
Signal Processing
AI algorithms filter and decode neural signatures

3
Intent Translation
Neural patterns mapped to specific commands

4
Robot Execution
Systems respond in real-time to neural directives

Key Recommendations

✓ Establish multidisciplinary ethics review boards
✓ Implement military-grade encryption protocols
✓ Develop international neurorights treaties
✓ Mandate transparent informed consent procedures
✓ Design fail-safe and manual override systems
✓ Conduct regular third-party security audits

Kamal Tasiu

UNIDIR

2025 innovations dialogue.

Neurotechnologies and their implications for international peace and security

24 November 2025 • 09:00–17:45 CET • Geneva and online

#ID25

UNIDIR.ORG

Merging Man and Machine: Weapon Control through Brain-Computer Interfaces

Denise Koecke

Active BCI

Through an active BCI, once the operating soldier identifies a target, he issues an explicit command to open fire by actively imagining to push a button with his right hand. The computer recognizes the ensuing neural signals and authorizes the UGV to strike.

Reactive BCI

The reactive BCI captures neural signals evoked instantly after the soldier has spotted a target, even before he becomes consciously aware of it. If he deems the target lawful, the brain signal is translated into a command to fire. Hence, the machine gun will fire before the operator can consciously make that decision.

Weapon control could be realized by having a soldier scan the battlefield through a camera attached to an unmanned ground vehicle. The soldier's task is to identify and engage lawful targets. Targets are struck by a machine gun mounted on top of the vehicle.

Problems of subconscious command under IHL

Distinction

Proportionality

Can the soldier sufficiently control his subconscious to ensure distinction and proportionality?

Drawing inspiration from the debate on lethal autonomous weapon systems (LAWS)

On-the-loop standard

supervise

review

abort

The reactive BCI does not enable the soldier to supervise the targeting process, to review a decision made, or to abort an attack. The operator is not "on-the-loop"; he does not retain meaningful human control over his subconscious. Thus, the targeting decisions reached via reactive BCI are not sufficiently predictable. The commander cannot predictably comply with the principles of distinction and proportionality as required under IHL.

Reactive BCIs as a mode of weapon control are unlawful

Denise Koecke, "Merging man and machine: A legal assessment of brain-computer interfaces in armed conflict", International Review of the Red Cross, Vol. 107, Issue 928: The Military, pp. 176-199

UNIDIR

2025 innovations dialogue.

Neurotechnologies and their implications for international peace and security

24 November 2025 • 09:00–17:45 CET • Geneva and online

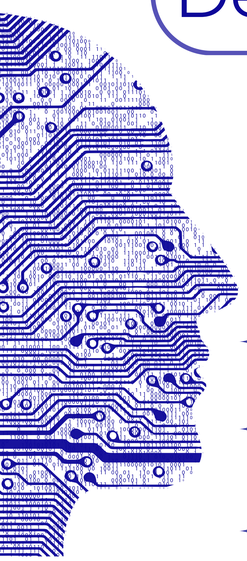
#ID25

UNIDIR.ORG

Designing Duty: The Lifecycle of Military Neurotech Responsibilities

By Pallavi Rengasamy, LL.B

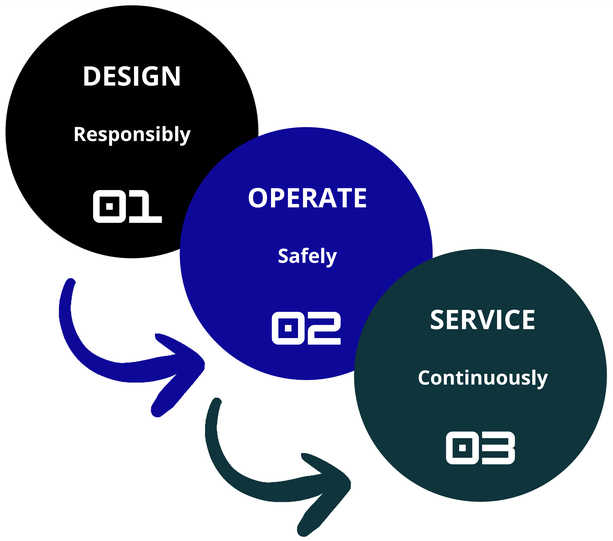
Scan for the abstract



System Component vs Sovereign Self

What constitutes responsible use of military neurotechnology?

- Tech outlives soldier: what failsafes to implement?
- Long-term effects on individual autonomy, cognitive integrity, and societal safety
- How to mitigate any form of brain-computer interface (BCIs) system-as-a-service?



00

Peer reviewed research basis, framed by rights-based approaches, regulatory oversight, ethical governance

01

Pre deployment architecture prioritising informed consent, biocompatibility monitoring, back out options

02

Protecting the human in brain-computer interfaces, autonomy, discernment, privacy

03

Right of repair, safeguarding of bio data, long-term palliative and reintegration protocols due to dual use nature

Neuro-enhanced service members not as assets but as lifelong ethical responsibilities

Knowledge baseline | **Risk averse** | **Self-determination** | **Care as a service** | **What comes after**

UNIDIR

2025 innovations dialogue.

Neurotechnologies and their implications for international peace and security

24 November 2025 • 09:00–17:45 CET • Geneva and online

#ID25
UNIDIR.ORG

Neo-Colonial Consciousness? A Framework to Understand the Risks Posed by Neurotechnologies in the Military Domain on the Human Experience

Justin Huang
BA International Studies, Leiden University
j.y.huang@umail.leidenuniv.nl
linkedin.com/justin-hyw

From Colonial to Neo-Colonial Consciousness

Colonial consciousness: Colonisers impose conceptual frameworks that are culturally alien to colonised peoples. The colonised lose access to their own experiences as they become able to articulate and understand their experiences only through these alien frameworks. The colonised internalise colonial descriptions of themselves.

Neo-colonial consciousness: Instead of just imposing alien frameworks, the use of neurotechnologies potentially takes things a step further, representing a direct implantation of such frameworks.

Implications for Neurotechnologies in Peace and Security

The individual's experience is re-structured by frameworks implanted by human developers through these machines. Lived experience risks becoming displaced as they come to be artificial and engineered. Thus, neurotechnologies may become a tool for cognitive colonisation, where decision-making, memory, and reflexes are re-programmed. In the process, agency, autonomy, and dignity are threatened.

Responsible innovation and use of neurotechnologies must therefore include safeguards that protect cognitive liberty, which can be understood as the right to access, interpret, and own one's consciousness. This helps ensure that neurotechnologies will complement and enhance rather than overwrite the human consciousness. Moral agency, cognitive autonomy, and human dignity must be preserved even as security advantages are pursued.

Further reading:

Balagangadhara, S. N. *Reconceptualizing India Studies*. Oxford University Press, 2012.

Gielas, Anna M. "Warfare at the Speed of Thought: Can Brain-Computer Interfaces Comply with IHL?" *ICRC Humanitarian Law & Policy*, August 21, 2025. https://blogs.icrc.org/law-and-policy/2025/08/21/warfare-at-the-speed-of-thought-can-brain-computer-interfaces-comply-with-ihl/.

Illes, Judy, Makarena Dudley, Lucia Machova Urdzikova, Ioana Podina, and Monique Pyrrho. "The Risk of Neurotechnology as an Instrument of Colonialism." *Brain Communications* 7, no. 3 (2025): fcaf139. https://doi.org/10.1093/braincomms/fcaf139

Kenneally, Christine. "Do Brain Implants Change Your Identity?" *The New Yorker*, April 21, 2021. https://www.newyorker.com/magazine/2021/04/26/do-brain-implants-change-your-identity.

1. **Fabrication of memories, sensations, and urges in combatants**
2. **Hacking of implants that alter decision-making or emotions during operations**

How can international humanitarian law, human rights law, etc. address such scenarios?

UNIDIR

2025
innovations dialogue.

Neurotechnologies and their implications for international peace and security

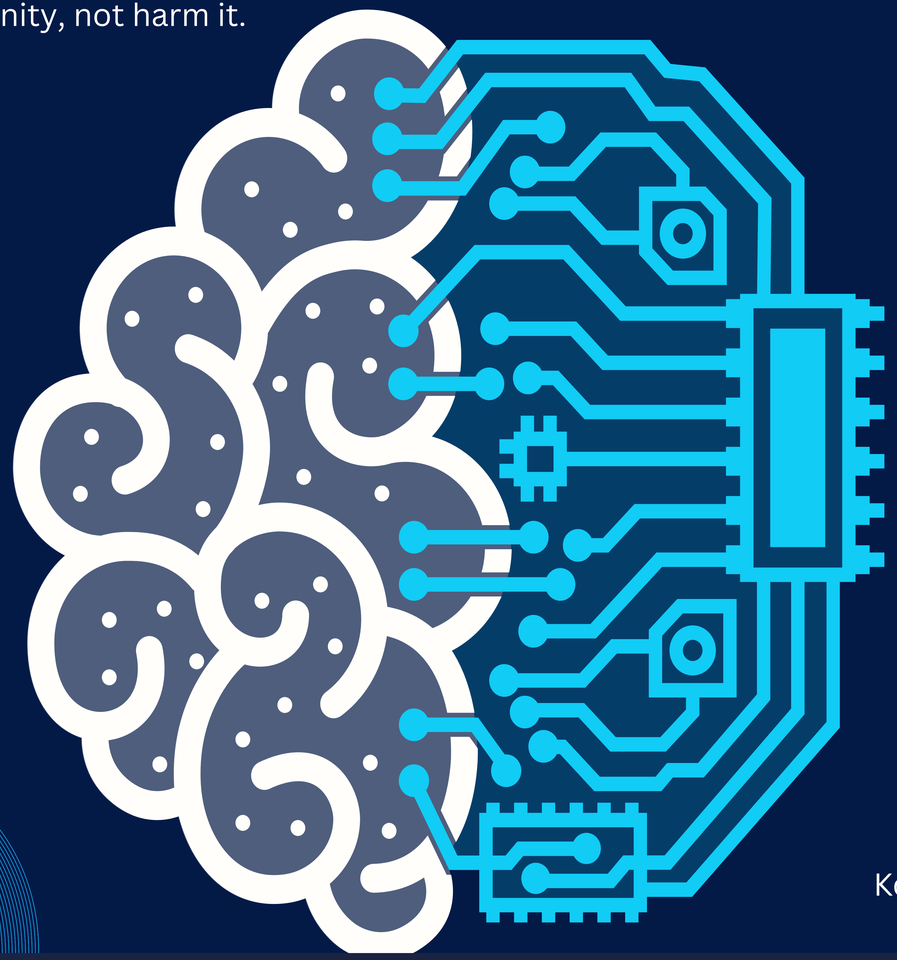
24 November 2025 • 09:00–17:45 CET • Geneva and online

#ID25
UNIDIR.ORG

NEUROVISION

PROMOTING RESPONSIBLE INNOVATION IN MILITARY NEUROTECHNOLOGY

- The use of neurotechnologies in the military brings both opportunities and risks.
- They can enhance decision-making, communication, and recovery for soldiers.
- These advances also raise serious ethical concerns about: Autonomy, Misuse, Humanitarian law
- A Four-Pillar Framework is introduced to ensure these technologies serve humanity, not harm it.



Kondwani mbale

1. CONTINUOUS OVERSIGHT AND ADAPTATION

- Integrate ethical and legal principle from the start of reasearch.
- Focus on consent,safety,and human diginity

2. TRANSPARENT COLLABORATION

- Foster cooperation among scientists, ethicists, policymakers, and defense experts.
- Promote open dialogue and shared responsibility in development.

THE FOUR PILLAR-FRAMEWORK

3. DUAL-USE GOVERNANCE

- Create safeguards to prevent therapeutic neurotools from being weaponized.
- Establish oversight mechanisms for responsible use.

4. CONTINUOUS OVERSIGHT AND ADAPTATION

- Establish ongoing monitoring of neurotechuse in defense.
- Update ethical and legal frameworks as technologies evolve