Topic Titles BERTopic-Generated R&D Topics	BERTopic- Generated Representation	Global R&D Topics Manually - Generated	BERTopic Description Manually-Generated
Autonomous Systems for Unmanned Aircraft Operations	[autonomous, systems, flight, uas, space, unmanned, mission, air, aircraft, data]	Aerospace	Development and optimization of autonomous systems for unmanned aircraft operations, including traffic management, mission planning, and integration into national airspace.
Advanced Sensors for High-Temperature and High-Pressure Monitoring	[sensor, inspection, sensors, measurement, temperature, measurements, pressure, monitoring, high, aircraft]	Aerospace	Development of advanced sensors for high-temperature and high-pressure monitoring in aerospace applications. Sensor technologies for capturing precise measurements in high-pressure and temperature environments, reducing emissions, and extending component lifespans.
Propulsion Systems and Engine Technologies for Spacecraft	[propulsion, engine, fuel, power, electric, propellant, thruster, high, thrust, control]	Aerospace	R&D related to innovative propulsion systems and advanced engine designs that maximize power, maneuverability, and efficiency and minimize weight and complexity.
Advanced Unmanned Aerial Systems (UAS)	[aircraft, flight, air, debris, vehicle, uas, payload, cargo, mission, vtol]	Aerospace	A focus on improving UAS through the integration of advanced aerodynamics, propulsion systems, and payload systems, as well as the ability to perform in remote or difficult-to-access areas. R&D aiming to enhance military and commercial operations by improving aircraft performance, increasing payload capacity, ensuring safety, and improving surveillance and emergency response capabilities.

Digital Health Technologies for Improving Healthcare Delivery and Patient Outcomes	[health, care, patient, patients, intervention, based, use, clinical, treatment, app]	Biological and Biomedical Technologies	Digital solutions for enhancing accessibility, effectiveness, and adherence to treatment for primary care providers and mental health professionals. This includes mobile apps and integrated platforms offering evidence-based tools for improving patient outcomes.
Genomics and Proteomics	[cell, dna, protein, sequencing, cancer, cells, proteins, rna, single, throughput]	Biological and Biomedical Technologies	R&D related to high-throughput sequencing methods, assay platforms, drug discovery, and understanding the complex interplay of RNA, DNA, and protein interactions in biomedical research.
Treatment and Monitoring Technologies for Patients with Heart-Related Conditions	[patients, heart, blood, clinical, patient, treatment, care, catheter, cardiac, phase]	Biological and Biomedical Technologies	Therapeutic strategies and approaches for improving treatment outcomes and enhancing the quality of life for patients with heart diseases or conditions. This includes advances in cardiac regeneration technologies and the development of implantable aritifical hearts. Non-invasive cardiac monitoring techniques for early intervention and prevention is also included.
Rapid Diagnostic Assays and Point-of-Care (POC) Tests for the Detection of Viral and Bacterial Pathogens.	[blood, assay, test, rapid, diagnostic, point care, detection, care, point, infection]	Biological and Biomedical Technologies	R&D focused on improving diagnostic capabilities, increasing the speed and accuracy of viral and bacterial pathogens, and developing diagnostic tools for low-resource settings.

Vaccine Technologies	[vaccine, virus, vaccines, hiv, influenza, infection, viral, immune, antibodies, antibody]	Biological and Biomedical Technologies	The development and optimization of innovative vaccine technologies for effective protection against various viral infections, including COVID-19, influenza, and respiratory syncytial virus (RSV). R&D addressing the challenges of current vaccine strategies.
Cancer Treatment and Therapy	[cancer, tumor, cells, cell, patients, tumors, clinical, treatment, therapy, drug]	Biological and Biomedical Technologies	Improving the efficacyof existing cancer treatments and therapies and addressing critical challenges in cancer therapy. Focus on the development of target immunotherapies and the improvement patient outcomes.
Bone and Tissue Repair	[bone, tissue, implant, cartilage, repair, clinical, surgical, treatment, joint, dental]	Biological and Biomedical Technologies	R&D addressing the limitations of current bone grafting techniques, improving clinical outcomes, reducing costs and healing times for patients requiring dental implants, treatments for degenerative joint diseases, and other bone and tissue treatments.
Alzheimer's Disease (AD) Treatment	[ad, disease, brain, alzheimer, tau, alzheimer disease, studies, clinical, drug, muscle]	Biological and Biomedical Technologies	R&D focused on halting or reversing AD progression and improve AD patient outcomes. This incudes innovations in early detection, diagnosis, therapeutic strategies, and identifying novel AD drug candidates.

Head and Neck Injury Prevention	[injury, blast, head, seat, helmet, injuries, body, neck, vestibular, combat]	Biological and Biomedical Technologies	Innovative strategies and technologies aimed at preventing head and neck injuries, particularly in high-risk environments such as combat, vehicle accidents, and youth sports. Research areas include development of novel materials, models for injury risk analysis, and improving designs for safey equipment.
Imaging Technologies for Breast Cancer Detection, Diagnosis, and Treatment	[imaging, cancer, clinical, breast, mri, contrast, ct, tumor, treatment, tissue]	Biological and Biomedical Technologies	Methods for nhancing diagnostic accuracy, reduce false positive rates, and improve patient outcomes by providing clearer images of breast tissue and tumors.
Pulmonary Disease Management and Treatment	[lung, pulmonary, patients, treatment, fibrosis, therapeutic, clinical, drug, studies, ards]	Biological and Biomedical Technologies	Exploration of novel drug formulations, exisiting medications, and other innovative innovative therapeutic approaches for treating lung conditions and improving lung fuction and patient outcomes.
Treatment of Diabetes and Related Liver Diseases	[insulin, diabetes, disease, liver, patients, treatment, cells, therapeutic, autoimmune, clinical]	Biological and Biomedical Technologies	Innovative therapies and technologies that address the underlying causes of diabetes and its complications.
Therapies and Technologies for Age-Related Macular Degeneration (AMD) and Other Retinal Diseases	[eye, retinal, vision, ocular, amd, corneal, glaucoma, blindness, treatment, dr]	Biological and Biomedical Technologies	R&D encompassing optogenetic treatments, automated screening systems for early detection, and comprehensive algorithms for eye disease evaluation.A focus on improving patient outcomes through early intervention, novel treatment options, and effective management of retinal diseases.

Disinfection and Decontamination	[disinfection, uv, decontamination, sterilization, pathogens, phase, use, plasma, bacteria, surfaces]	Biological and Biomedical Technologies	Disinfection technologies for decontaminating surfaces and inactivating airborne pathogens. Potential applications relate to healthcare, food preparation, and everyday environments.
Surgical Technologies	[surgical, surgery, tissue, clinical, imaging, patients, cancer, procedures, nerve, patient]	Biological and Biomedical Technologies	Development of advanced tools and methodologies for enhancing patient outcomes by minimizing surgical trauma, reducing recovery times, and decreasing healthcare costs.
Treatment of Chronic and Neuropathic Pain	[pain, opioid, treatment, chronic, drug, neuropathic, studies, chronic pain, neuropathic pain, effects]	Biological and Biomedical Technologies	Innovative approaches for treating chronic and neuropathic pain while minimizing the risks associated with opioid use.
in vitro Toxicity Testing	[cell, drug, human, vitro, cells, assay, toxicity, screening, culture, assays]	Biological and Biomedical Technologies	Streamlining of drug development processes, reducing reliance on animal testing, and improving patient safety by identifying potential cardiotoxicity early in the drug development pipeline. Development of predictive screening methods for assessing the safety of new drugs, particularly in the context of cardiotoxicity.
Enhancing Human Performance	[performance, cognitive, training, fitness, physiological, workload, human, readiness, stress, physical]	Biological and Biomedical Technologies	R&D related to advanced training systems, utilization of human performance analytics, and addressing challenges such as fatigue and injury prevention.
Novel Antimicrobial Therapies to Combat Multi-Drug Resistant (MDR) Bacterial Infections	[infections, resistant, resistance, antibiotic, drug, antibiotics, bacterial, compounds, bacteria, novel]	Biological and Biomedical Technologies	Research aiming to enhance the efficacy and reduce toxicity of existing antibiotics, and address the urgent need for new treatments against MDR bacteria that pose significant health and economic challenges.

Treatment of Chronic / non-Healing Wounds	[wound, healing, wounds, skin, wound healing, tissue, diabetic, burn, dressing, chronic]	Biological and Biomedical Technologies	R&D focusing on innovative approaches to wound healing, particularly for chronic and diabetic wounds that are difficult to treat (i.e. non-healing wounds). Therapeutic strategies, including advanced dressings, biomaterials, and treatments designed to enhance tissue regeneration, improve healing rates, and reduce complications such as infections.
Neural Technologies	[stimulation, brain, neural, pain, recording, electrode, eeg, implantable, wireless, research]	Biological and Biomedical Technologies	Improving neural representation and stimulation techniques, particularly focusing on innovative methods for recording and modulating brain activity. Exploration of brain functions related to pain and other neurological conditions. Commercialization of new devices to accelerate neuroscience research and clinical applications.
Inflammatory Bowel Disease (IBD) and the Gut Microbiome	[gut, ibd, inflammatory, microbiome, intestinal, disease, bowel, colitis, inflammatory bowel, oral]	Biological and Biomedical Technologies	Research and development of novel therapeutic approaches leveraging microbiome interactions to mitigate inflammatory processes in the gastrointestinal tract. Emphasis on the use of specific bacterial strains and their molecular components to promote anti-inflammatory responses and improve patient outcomes.
Hearing Health	[hearing, speech, noise, hearing loss, ear, loss, hearing protection, hearing aid, auditory, sound]	Biological and Biomedical Technologies	Various aspects of hearing health, with a focus on hearing loss, auditory processing, and noise-related injuries. Innovative technologies that enhance hearing clarity and protection.

Therapeutic Potentials of Glycosaminoglycans	[glycan, glycans, glycosylation, hs, oligosaccharides, sulfate, protein, milk, heparan, heparan sulfate]	Biological and Biomedical Technologies	R&D enhancing the understanding of glycan functions in health and disease, facilitating the development of therapeutic applications, and providing resources for functional glycomics.
Antenna Technologies and Communication systems	[antenna, communications, radio, rf, band, interference, frequency, spectrum, network, communication]	Communication Technologies	Creation of lightweight and efficient antenna systems for a wide variety of military and commercial applications and the development of robust communication architectures for reliable data transfer in diverse environments and contexts.
Solid-State Power Amplifiers (SSPAs)	[band, power, amplifier, power amplifier, sspa, ghz, mmic, efficiency, pae, gan]	Communication Technologies	Development of SSPAs for various frequency bands. Advancements must meet demanind performance standards and criteria related to high output power and thermal managemen for applications in satellite communications, military operations, and space exploration. Innovations addressing the growing need for efficient communication systems in congested frequency bands.
Solar Cell Technologies	[solar, high, power, array, solar cells, energy, cells, phase, silicon, efficiency]	Energy	Innovative approaches to enhance the performance and flexibility of silicon solar cells. Overarching theme of developing high-power, efficient, and cost-effective solar solutions that are able to be deployed in diverse conditions.

Battery Technology	[battery, batteries, lithium, ion, energy, li, lithium ion, electrolyte, energy density, ion batteries]	Energy	R&D advancing lithium-ion battery technologies and improving energy density, efficiency, and operational performance of lithium-ion batteries. Applications range from aerospace, to consumer electronics, to electric vehicles.
Building Energy Management and Efficiency through Advanced Data Modeling, Machine Learning, and Smart Technologies	[data, building, energy, buildings, phase, research, software, innovation, wind, models]	Energy	Development of software solutions and predicitive models for for real-time energy management, the implementation of smart control systems, and the design of energy-efficient building materials such as biochromic windows.
Energy Storage and Power Conversion Technologies	[power, energy, storage, grid, energy storage, heat, dc, converter, solar, high]	Energy	R&D facilitating the transition to cleaner energy systems and enhancing the efficiency of power distribution and usage. Advanced storage solutions and power management technologies for integrating renewable resources into the grid.
High-Power Electron Accelerators	[beam, electron, rf, accelerator, accelerators, high, power, srf, cavities, cavity]	Energy	Advancements in high-power electron accelerators, particularly superconducting radio frequency (SRF) technology and the development of innovative electron guns and power sources.
Proton Exchange Membrane (PEM) Fuel Cell Technology	fuel, membranes, hydrogen, fuel cell, membrane, fuel cells, exchange, pem, cell, proton]	Energy	Creation of more efficient fuel cells capable of operating under high-temperature conditions while addressing durability challenges. Innovations facilitating the commercialization of hydrogen fuel cells in transportation and stationary power applications.

Water and Wastewater Treatment	[water, wastewater, phase, pfas, waste, cost, food, energy, production, treatment]	Environmental Technologies	Technologies for water and wastewater treatments, focusing on the detection and remediation of contaminants. R&D applications include water quality monitoring, sustainable purification methods, and devices and methodologies for the detection and remediation contaminants like PFAS and lead.
Agricultural Technologies	[food, crop, soil, production, farmers, plant, crops, agricultural, farms, agriculture]	Environmental Technologies	Innovative approaches and technologies in agriculture aimed at improving crop production and sustainability. This includes the advancement of soil management capabilities, sensors for collecting crop and environmental data, enhancing precision agriculture practices, and supporting resilient and efficient agricultural systems.
Sensor Technologies for Atmospheric Monitoring	[sensor, gas, chemical, monitoring, air, sensors, detection, instrument, exposure, phase]	Environmental Technologies	Advanced sensor technologies for monitoring and detecting various gases and particulate matter in the atmosphere. A focus on improving air quality monitoring, enhancing environmental research, and supporting public health initiatives by providing accurate, continuous data on air pollution and chemical exposure.
Carbon Dioxide (CO2) Capture and Utilization	[co2, carbon, gas, capture, coal, dioxide, carbon dioxide, energy, sorbent, separation]	Environmental Technologies	Technologies aiming to improve the efficiency, efficacy, and cost-effectiveness of CO2 capture and conversion mechanisms for industrial processes, natural gas, and coal-fired power plants. R&D with a focus on contributing to deep decarbonization of the energy sector.

Biotechnologies and Processes for the Sustainable Production of Chemicals and Fuels	[production, biomass, waste, chemicals, products, fermentation, carbon, bio, renewable, acid]	Environmental Technologies	Creation of cost-competitive alternatives to petroleum-based production while addressing greenhouse gas emissions and promoting a circular bioeconomy. Sustainable production of chemicals and fuels from renewable biomass feedstocks.
Augmented reality (AR), Virtual Reality (VR), and Haptic Technologies for Training and Educational Applications	[training, reality, virtual, ar, augmented, augmented reality, vr, display, learning, simulation]	Learning and Education	Augmented reality (AR), virtual reality (VR), and haptic technologies intended to enhance training and educational experiences across various fields. Immersive simulations to prepare professionals for real-world scenarios.
Educational Technologies for STEM Learning	[students, learning, stem, student, school, teachers, game, education, educational, skills]	Learning and Education	R&D exploring various approaches for enhancing STEM learning and engagment among students. Approaches include interactive digital platforms, virtual reality experiences, and game-based learning tools that promote critical thinking, collaboration, and hands-on experimentation
Security Enhancment, Data processing, and Scientific Research	[data, security, software, systems, cyber, information, network, analysis, mission, learning]	Machine Learning and AI	Development and application of machine learning, artificial intelligence, and data analytics tools to address complex challenges in various high-impact fields such as cybersecurity, real-time data streaming, biological and environmental sciences, and strategic security management.

Computational Methods for Simulating and Analyzing Fluid-Structure Interactions	[simulation, modeling, simulations, cfd, computational, software, models, fidelity, analysis, model]	Machine Learning and AI	Enabling easier access to complex simulations, reducing computational costs, and facilitating the integration of simulation tools across various engineering disciplines. Technologies for simulating and analyzing fluid-structure interactions in the context of aerospace, wind energy, and nuclear energy systems.
Acoustic Sensing and Data Analysis Technologies for Underwater Applications	[acoustic, underwater, sonar, ocean, sensor, data, navy, sonobuoy, array, submarine]	Machine Learning and AI	Innovative solutions that leverage novel signal processing techniques and integrated sensor technologies to enhance situational awareness and sonar performance in complex underwater environments, like anti-submarine warfare (ASW). Devlopment of algorithms for acoustic noise removal, environmental inference frameworks using deep learning, and systems for real-time acoustic monitoring.
Analysis and interpretation of Imagery and Video Data	[learning, imagery, data, deep, video, object, deep learning, image, detection, algorithms]	Machine Learning and AI	Research aiming to address challenges in computer vision, particularly for remote sensing and full motion video, with applications in public safety, national security, and commercial industries. Development of deep learning methodologies and innovative algorithms and systems designed to enhance object detection, classification, and risk assessment using satellite and aerial imagery.

Memory Computing Technologies and Architectures for High-Performance Computing (HPC) Systems	[memory, computing, performance, hardware, applications, processor, hpc, data, high performance, processing]	Machine Learning and AI	R&D focused on improving memory access, power efficiency, and overall system performance for data-intensive applications across various industries.
Efficient Thermal and Energy Management in High-Temperature and Harsh Environments	[power, heat, high, thermal, phase, temperature, energy, systems, materials, cooling]	Materials Science, Advanced Manufacturing, and Instrumentation	R&D related to materials science and thermal management systems for address critical needs in the context of energy efficiency and performance across various engineering and scientific applications.
Additive Manufacturing	[manufacturing, additive, additive manufacturing, parts, 3d, printing, materials, material, metal, components]	Materials Science, Advanced Manufacturing, and Instrumentation	Application of additive manufacturing techniques and processes for the production of high-performance materials and compenents. Innovative applications of 3D printing processes for reducing production time and cost of manufacturing alloys, parts, and other materials for a wide range of applications and industiries.
High-Temperature Superconducting (HTS) Materials for Advanced Magnet Technologies	[high, magnetic, magnets, cable, superconducting, power, magnet, cables, wire, field]	Materials Science, Advanced Manufacturing, and Instrumentation	R&D related to superconducting magnet technology for energy and medical applications. Applications range from fusion to magnetic resonance imaging (MRI).
Advanced Coatings and Surface Treatments	[coating, coatings, corrosion, materials, components, material, aircraft, phase, surface, composite]	Materials Science, Advanced Manufacturing, and Instrumentation	A focus on sustainable, multifunctional, low-cost coatings that meet industry and environmental regulatory standards. Innovative approaches for enhancing corrosion resistance and wear protection for various materials used in aerospace and industrial contexts.

Composite Materials and Manufacturing Techniques	[composites, composite, carbon, fiber, materials, resin, manufacturing, material, carbon fiber, high]	Materials Science, Advanced Manufacturing, and Instrumentation	Advancements in carbon fiber composite materials and manufacturing techniques for enhancing performance and reducing costs across various industries. Using f advanced composites to replace traditional materials, reduce vehicle weight, and contribute to energy savings while addressing environmental concerns.
Optical Metrology and the Development of Freeform Optical Components	[optical, optics, mirror, mirrors, metrology, freeform, phase, lens, manufacturing, ray]	Materials Science, Advanced Manufacturing, and Instrumentation	R&D addressing the challenges associated with measuring and manufacturing complex optical surfaces, such as mirrors and lenses, that lack symmetry and have varying curvatures. Emphasis on cost reduction, improving efficiency in optical systems, and exploring the potential of new materials and designs to revolutionize optical component manufacturing and performance.
Flame-Retardant Textiles and Fabrics	[fabric, textile, fabrics, flame, textiles, skin, materials, counterfeit, phase, fr]	Materials Science, Advanced Manufacturing, and Instrumentation	Advancements in the development of flame-retardant textiles and fabrics, particularly for applications in military and aerospace environments.
Modeling and Analysis of Fatigue Damage in Composite Materials	[fatigue, damage, composite, crack, modeling, material, composites, model, materials, loading]	Materials Science, Advanced Manufacturing, and Instrumentation	Research aiming to improve the design and performance of advanced materials in various engineering applications. This includes the development of innovative computational tools for predicting the life and durability of materials.

Wide Bandgap Materials for High-Power Electronic Devices	[gan, sic, power, devices, substrates, voltage, high, power electronics, ga2o3, electronics]	Materials Science, Advanced Manufacturing, and Instrumentation	Production and application of wide bandgap materials, particularly gallium nitride (GaN) and silicon carbide (SiC), in high-power electronic devices. Improving the scalability and cost-effectiveness of GaN device manufacturing.
Analog-to-Digital Converters (ADCs) and Application-Specific Integrated Circuits (ASICs) for Signal Processing	[adc, asic, digital, analog, low power, low, sampling, signal, physics, adcs]	Materials Science, Advanced Manufacturing, and Instrumentation	Advancements in ADC technology supporting a wide range of applications, from high-energy physics experiments to general-purpose instrumentation and autonomous systems, with a focus on commercial viability and scalability in the growing data converter market.
High-Power Laser Technologies	[laser, optical, fiber, quantum, high, lasers, power, photonic, beam, high power]	Photonics	Development of efficient laser systems for a wide variety of commercial and defense applications. A focus on the role of photoonics in improving performance, scalability, and efficiency of laser systems.
Hyperspectral Imaging	[hyperspectral, spectral, atmospheric, imaging, sensor, measurements, cloud, instrument, data, turbulence]	Photonics	Sensor design, platform integration, and the development of algorithms for real-time data processing. Overall theme of improving detection capabilities in complex environments and facilitating the monitoring of atmospheric conditions and objects across various sectors like agriculture, public health, and defense.

Radiation Detection Technologies	[ray, neutron, detector, detectors, nuclear, radiation, high, gamma, resolution, detection]	Photonics	Research efforts centered around the creation of compact, high-resolution detection systems and materials for applications in nuclear safety, medical imaging, and scientific research, with significant implications for nuclear material accountability and emergency response. Detection of gamma rays and neutrons, especially.
Advanced Radar Technologies and Methodologies	[radar, sar, target, radars, processing, clutter, aperture, targets, synthetic aperture, aperture radar]	Photonics	Development of innovative radar waveforms, signal processing techniques, and system architectures that improve geolocation accuracy, reduce clutter interference, and optimize performance in challenging environments. A focus on enhancing target recognition and detection capabilities for surveillance and military applications.
Infrared (IR) focal plane arrays (FPAs) and detector Technologies	[infrared, focal plane, focal, plane, arrays, detector, pixel, fpa, high, fpas]	Photonics	R&D improving imaging systems (IR and FPA detector technologies) used across various sectors, including military and space applications.
Advanced Electron Microscopy	[microscopy, electron, resolution, imaging, microscope, sample, tem, cryo, electron microscopy, em]	Photonics	R&D facilitating high-resolution imaging of complex structures related to biomolecular functions and interactions. Improvements in sample preparation, imaging resolution, and the ability to capture dynamic processes in biological, energy, and material sciences.

OLED (Organic Light Emitting Diode) Lighting Technology	[lighting, oled, light, led, leds, state lighting, emitting, light emitting, color, efficiency]	Photonics	R&D addressing challenges such as improving light extraction efficiency, reducing production costs, and enhancing the performance OLED systems. Exploration of innovative materials and methods for OLED systems that would facilitate widespread OLED adoption in solid-state lighting, potentially leading to environmental and economic benefits.
Vehicle Technology and Traffic Management	[vehicle, vehicles, traffic, driving, data, safety, road, transportation, passenger, driver]	Transportation Technologies	Efforts aiming to reduce accidents, improve traffic flow, and promote sustainable transportation solutions. This also includes innovations in autonomous vehicle safety and teleoperation technologies, as well as the application of advanced sensors in vehicles and traffic control managment.
Inertial Measurement Units (IMUs) and Related MicroElectroMechanical Systems (MEMS) Technologies	[inertial, mems, imu, navigation, gyroscope, sensors, accelerometer, sensor, inertial measurement, gyroscopes]	Transportation Technologies	R&D related to IMUs and related MEMS technologies for navigation and orientation applications. Creation of miniaturized, affordable navigation solutions for various industries that enhance precision and functionality in challenging environments.
Positioning, Navigation, and Timing (PNT) Technologies	[gps, pnt, navigation, signals, positioning, position, jamming, navigation timing, timing, spoofing]	Transportation Technologies	Development of resilient navigation systems utilizing inertial sensors, collaborative networks, and low Earth orbit (LEO) satellite constellations to provide accurate PNT information. Specifically, advanced solutions for PNT in environments where GPS is unavailable or compromised.