INTELLIGENT MULTISCALE & MULTIFUNCTIONAL MANUFACTURING LAB.

부산대학교 PUSAN NATIONAL UNIVERSITY

Intelligent Multiscale & Multifunctional Manufacturing Technologies

Additive Manufacturing, Micro/nano fabrication, Biomedical Applications

박 석 희 (Suk-Hee Park) Ph.D., Associate Professor

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https://sites.google.com/view/3mlab-pnu/home

Research Overview – Digital manufacturing

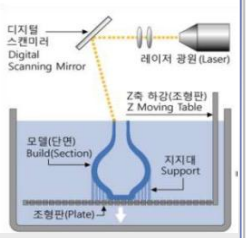
3D Design (Scanning/Modeling)

3D Printing

Post-processing

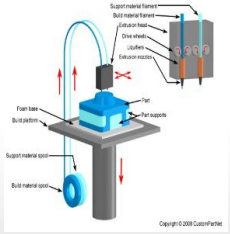
Final 3D Product

VP
(Vat photopolymerization)



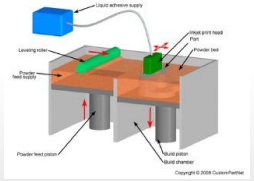
Stereolithography
Carima, 3D Systems, etc.

ME
(Material extrusion)



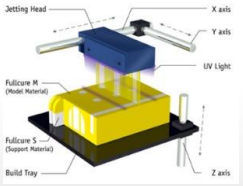
Fused Deposition Modeling
Rokit, Stratasys, etc.

BJ
(Binder Jetting)



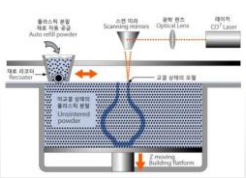
3DP
3D Systems (Z-corp), etc.

MJ
(Material Jetting)



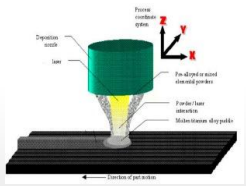
Polyjet, Multijet
Stratasys (Objet), etc.

PBF
(Powder Bed Fusion)



Selective Laser Sintering
EOS, etc.

DED
(Directed Energy Deposition)



Direct Metal Tooling
Insstek, Optomec, etc.

Manufacturing with digital data (image and numerical data)

Application of machine learning techniques

AI-assisted design & manufacturing

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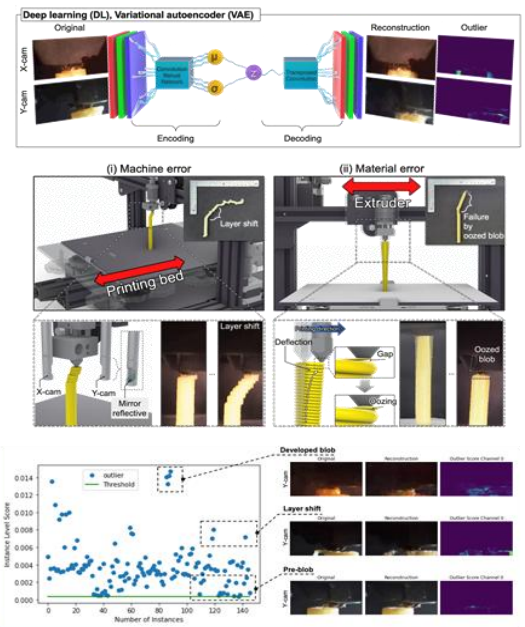
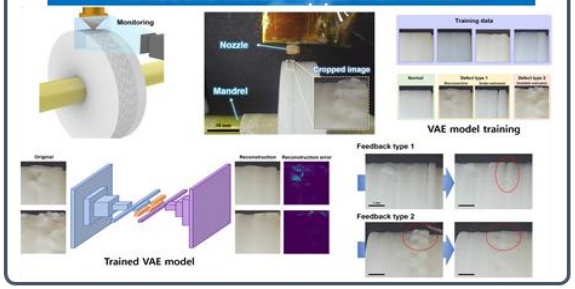
AI-assisted manufacturing with autonomous defect detection and correction

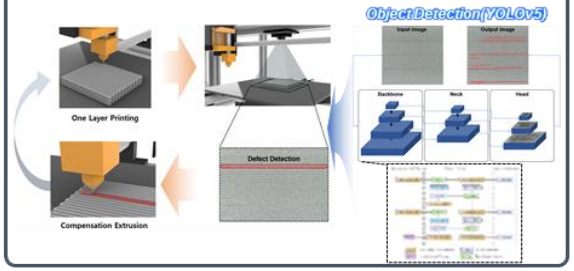
Image-based anomaly detection With VAE-deep learning model



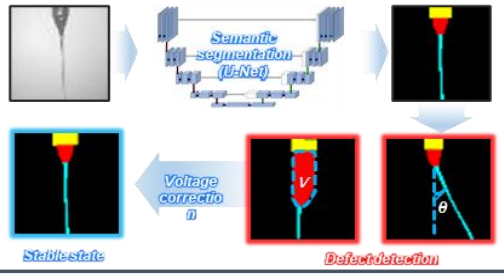
Anomaly detection and feedback system in additive lathe process with VAE-DL



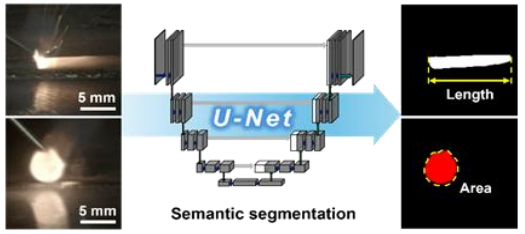
In-situ Selective Defect Compensation in MEX Process using Object Detection



Semantic segmentation for automatic voltage control in electrospinning

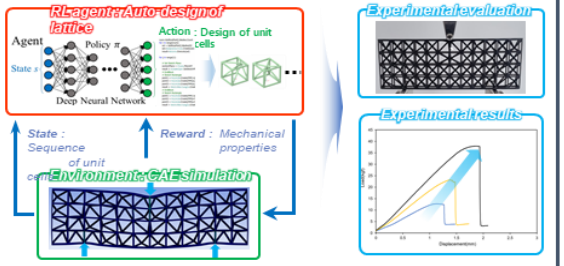


Real-time monitoring in wire-based welding and DED using U-Net

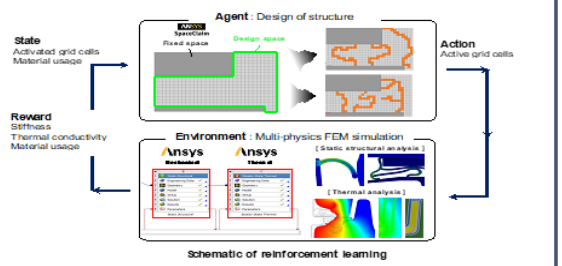


AI assisted design optimization with autonomous selection of geometry parameters

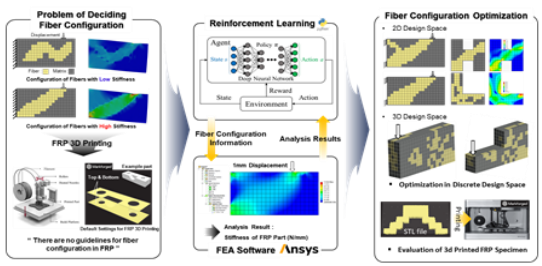
Reinforcement learning based lattice design for optimized performance



Design optimization via reinforcement learning and multi-physics FEA

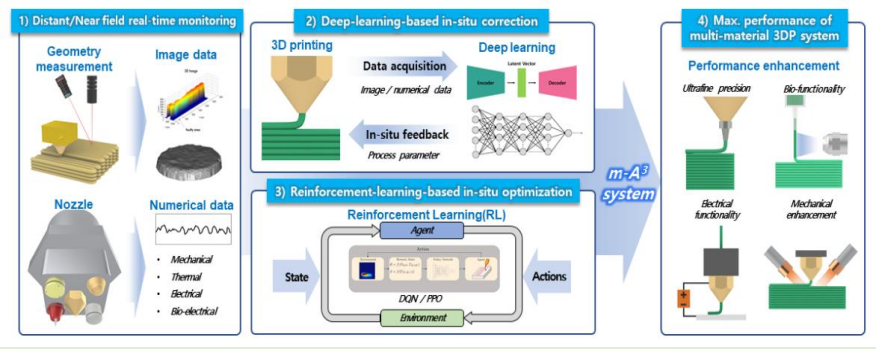


Reinforcement learning with FEA for design of 3D printed composites



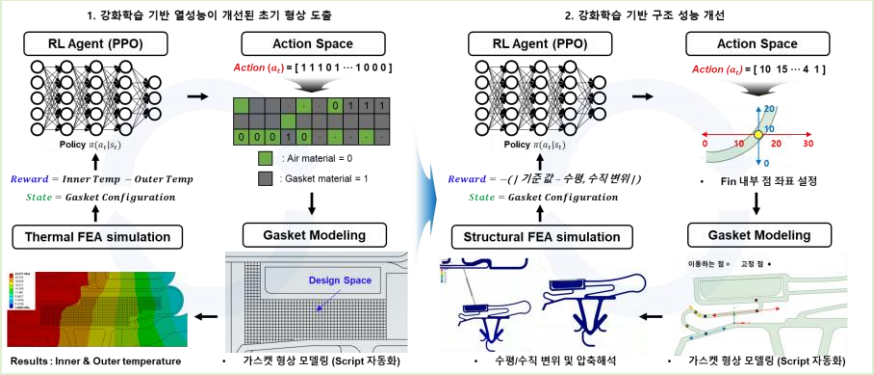
AI-assisted design & manufacturing

근-원거리 물성-형상 실시간 동시 모니터링을 통한 머신러닝 기반 다중소재 3차원 프린팅 공정(연구재단, '23~'27)

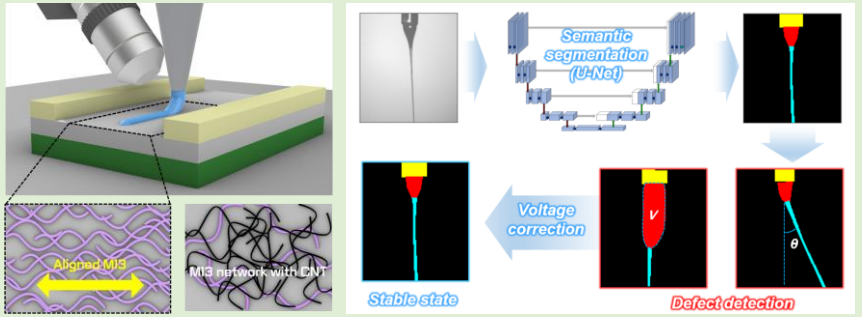


맞춤형 무기체계 제조를 위한 경량합금-SEP 소재의 복합 적층제조기술 개발 (방위사업청, '23~'29)

에너지 노즈 개선 가스켓 단면 개발 (LG전자 민간수탁과제, '24~'25)



휴머노이드 후각디스플레이센터 (한국연구재단 글로벌 선도연구센터 (IRC), '24~'34)



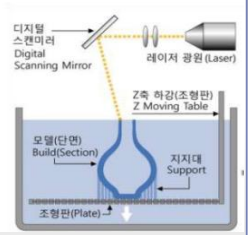
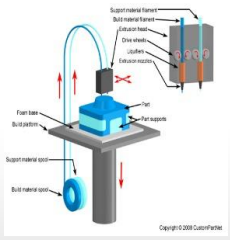
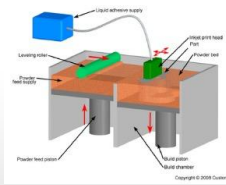
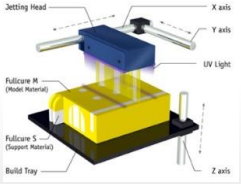
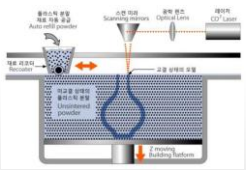
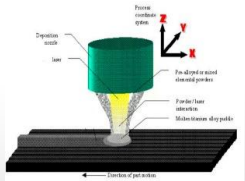
Research Overview – Functionalization

3D Design (Scanning/Modeling)

3D Printing

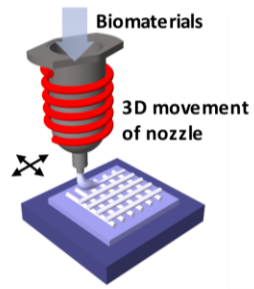
Post-processing

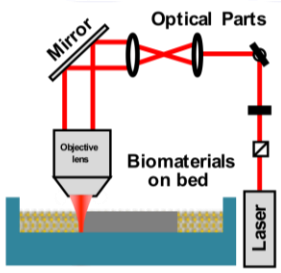
Final 3D Product

VP (Vat photopolymerization)	ME (Material extrusion)	BJ (Binder Jetting)	MJ (Material Jetting)	PBF (Powder Bed Fusion)	DED (Directed Energy Deposition)
					
Stereolithography Carima, 3D Systems, etc.	**Fused Deposition Modeling** Rokit, Stratasys, etc.	**3DP** 3D Systems (Z-corp), etc.	**Polyjet, Multijet** Stratasys (Objet), etc.	**Selective Laser Sintering** EOS, etc.	**Direct Metal Tooling** Insstek, Optomec, etc.

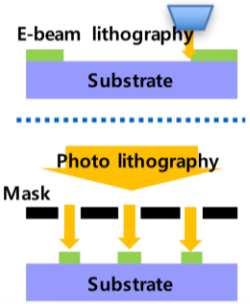
Development of Multiscale/Multimaterial Convergence Technology

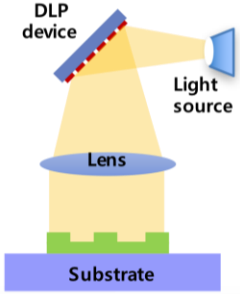
Additive Manufacturing / 3D Printing



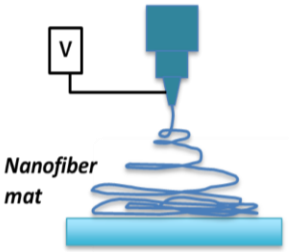


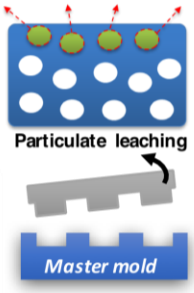
Micro/Nano fabrication Techniques





Chemical Engineering Techniques





Medical & Electronic applications

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- Additive manufacturing
- Lithographic pattering
- Thin-film deposition

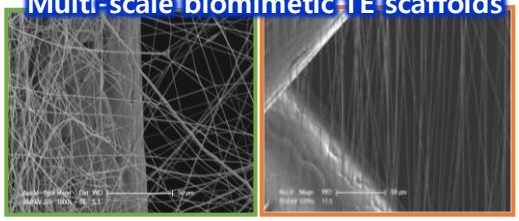
Multiscale/Multimaterial Fabrication

- 3D, 2D printing process
- Electrohydrodynamic jetting
- Leaching, Replicating process

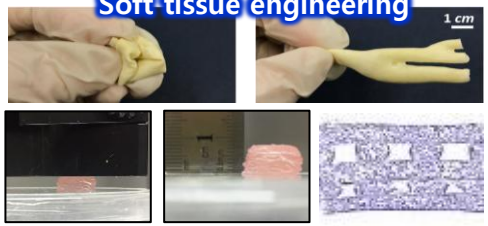
M1 Tissue Engineering / Implantable Biomedical Device

- Multiscale tissue engineering scaffold via 3D printing and electrospinning
- Patient-specific medical device based on medical imaging of CT/MRI
- Soft/Hard tissue engineering based on mechanical biocompatibility

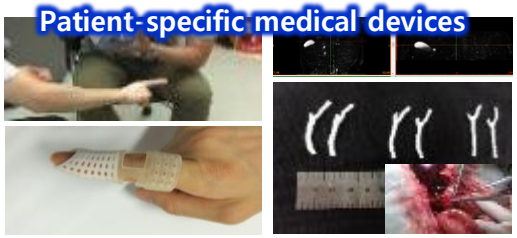
Multi-scale biomimetic TE scaffolds



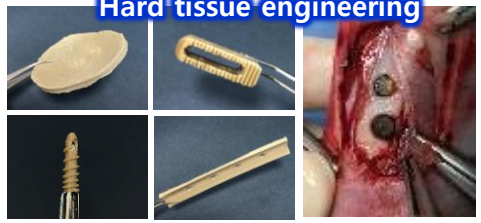
Soft tissue engineering



Patient-specific medical devices



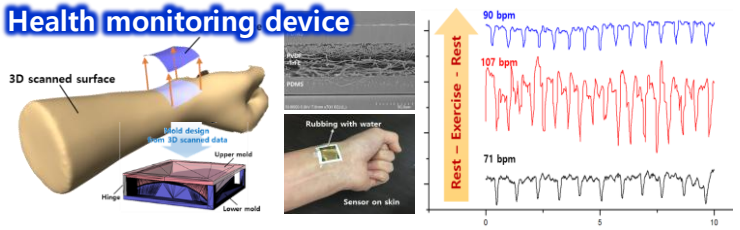
Hard tissue engineering



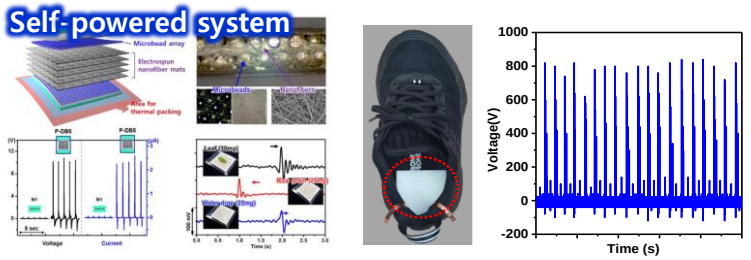
M2 Wearable Electronics / Health monitoring device

- Flexible physical sensor for pulse monitoring
- 3D customized interface for wearable device
- Self-powered system using piezo/triboelectricity

Health monitoring device



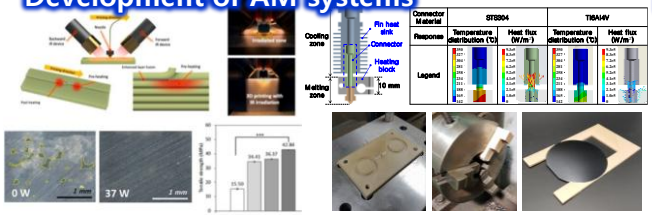
Self-powered system



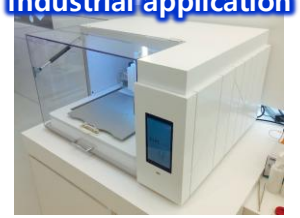
M3 Process Development

- Development of AM
- Industrial applications
- 4DP & Machine learning

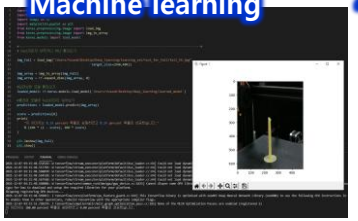
Development of AM systems



Industrial application



Machine learning

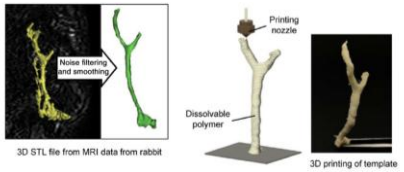


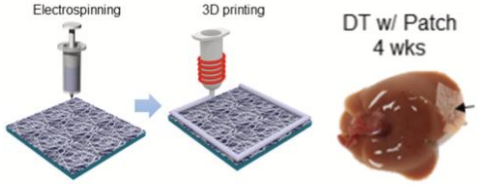
4D printing

Collaboration with MD's groups

Liver tissue engineering

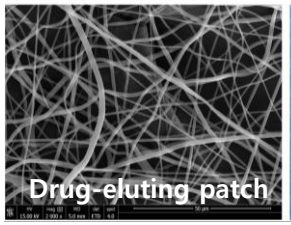
한양대학교병원 HANYANG UNIVERSITY SEOUL HOSPITAL

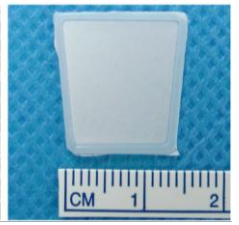


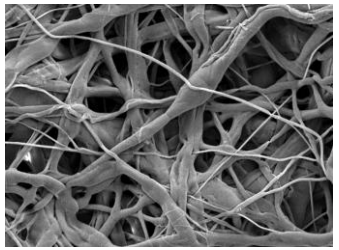


Orthopedic biomedical device

SNUH 분당서울대학교병원

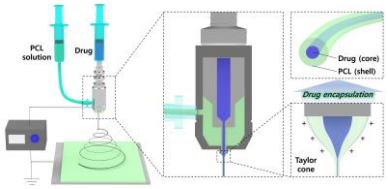


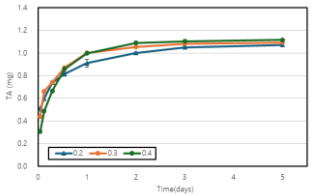




Drug eluting stent

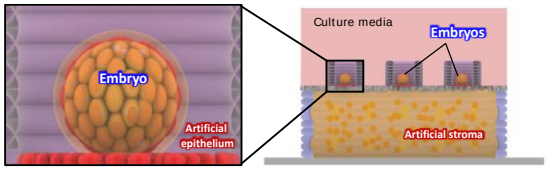
SAMSUNG 삼성서울병원

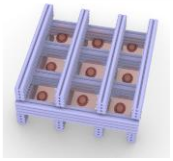


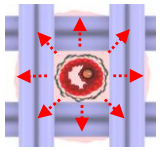


Biomimetic culture platforms for IVF

CHA 의과학대학교 CHA 차병원그룹

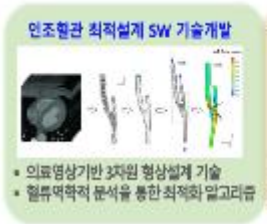


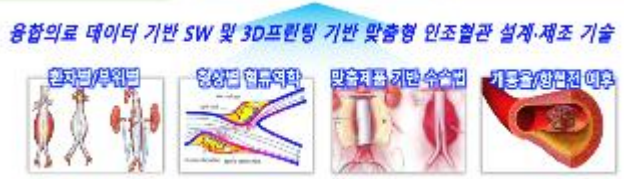




Artificial vascular grafts

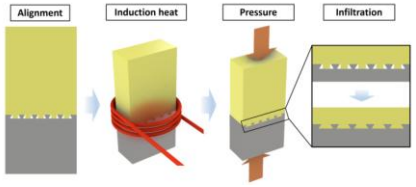
고려대학교안산병원 KOREA UNIVERSITY ANSAN HOSPITAL

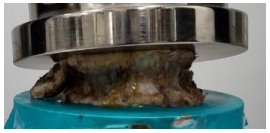




Metal-Polymer hybrid implants

PNUH 부산대학교병원 Pusan National University Hospital





https://sites.google.com/view/3mlab-pnu

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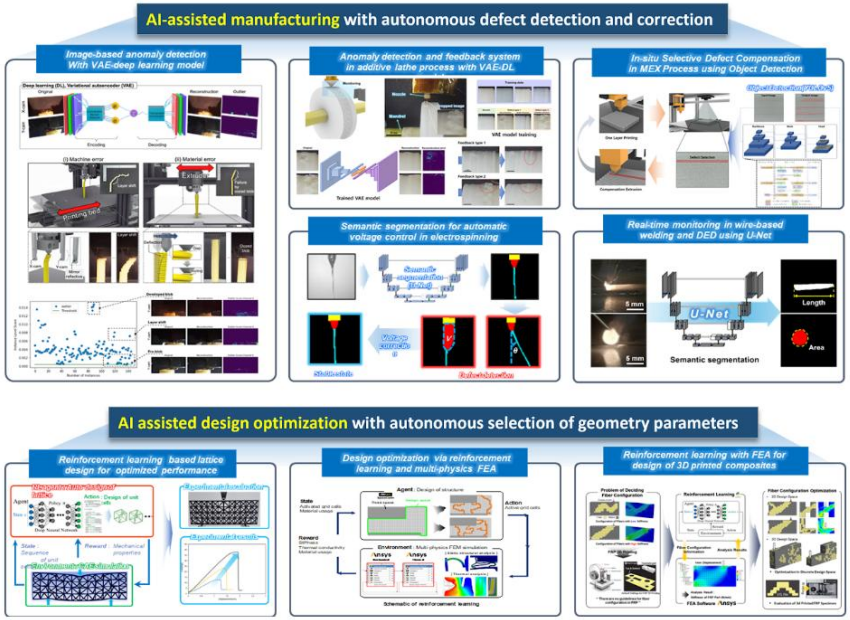

ANNOUNCEMENTS

▪ **연구분야**

- AI 기반 제조공정 결함검출/개선, 생산성 향상 및 지능화 공정개발
- AI 기반 지능형 최적설계 기술
- 다중소재/다중스케일 적층제조 공정개발 및 산업응용
- 방위산업/바이오/의료/자동차/항공우주 등 산업활용 적층제조기술
- 나노/바이오소재 기반 센서 제조기술

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