

# Sangwoon Kwak

Senior Researcher, ETRI (s.kwak@etri.re.kr)

Personal page

## EDUCATION

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**Korea Advanced Institute of Science and Technology, KAIST** Daejeon, Korea  
Ph.D of Science., Major: Electrical Engineering (Advisor: Prof. Munchurl Kim) Mar. 2021 – Feb. 2026

- Thesis: 4D Scene Reconstruction based on Dynamic 3D Gaussian Splatting using Global-to-Local Motion Decomposition [\[link\]](#)
- GPA: 4.01 / 4.3

**Korea Advanced Institute of Science and Technology, KAIST** Daejeon, Korea  
Master of Science., Major: Electrical Engineering (Advisor: Prof. Youngchul Sung) Mar. 2012 – Feb. 2014

- Thesis: An Extended Least Difference Greedy Clique-Cover Algorithm for Index Coding [\[link\]](#)
- GPA: 3.98 / 4.3

**Yonsei University** Seoul, Korea  
Bachelor of Science., Major: Electrical and Electronic Engineering Mar. 2008 – Feb. 2012

- National Science & Engineering Scholarship (Full tuition)
- GPA: 3.57 / 4.3

## RESEARCH EXPERIENCES

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**Electronics and Telecommunications Research Institute, ETRI** Daejeon, Korea  
Senior Researcher with Media Research Division Mar. 2014 – Present

## RESEARCH INTERESTS

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**Immersive video and computer vision applications, including:**

3D/4D scene representation, Novel view synthesis, Video coding for machines

## PUBLICATIONS

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- [1] E. An, A. Kim, S. Jung, **S. Kwak**, J. Lee, W.-S. Cheong, K. Seo<sup>†</sup> “Adaptive spatial down-sampling method based on object occupancy distribution for video coding for machines,” *EURASIP Journal on Image and Video Processing*, Vol.36, No. 1, Oct. 2024.
- [2] Y. Kim, J. Yun, **S. Kwak**, I. Ihm<sup>†</sup> “Ray tracing-based construction of 3D background model for real-time stereoscopic rendering of live immersive video,” *Virtual Reality*, 28(1), 17. Jan. 2024.
- [3] **S. Kwak**, J. Yun<sup>†</sup>, J.-Y. Jeong, Y. Kim, I. Ihm, W.-S. Cheong, J. Seo “View Synthesis with Sparse Light Field for 6DoF Immersive Video,” *ETRI Journal*, Vo.44, No. 1, Feb. 2022. [\[link\]](#)
- [4] M.-S. Baek, **S. Kwak**, J.-Y. Jung, H. M. Kim, D.-J. Choi “A Supplementary Explanation for Experimental Environment of “Implementation Methodologies of Deep Learning-Based Signal Detection for Conventional MIMO Transmitters”,” *IEEE Transactions on Broadcasting*, Vol.67, No.1, Oct. 2020.
- [5] M.-S. Baek, **S. Kwak**, J.-Y. Jung, H. M. Kim, D.-J. Choi “Implementation Methodologies of Deep Learning-based Signal Detection for Conventional MIMO Transmitters,” *IEEE Transactions on Broadcasting*, Vol.65, No.3, Sep. 2019.

- [1] **S. Kwak\***, W. Kwon\*, J. Jeong, G. Kim, W-S. Cheong, J. Oh<sup>†</sup>, “MoRel: Long-Range Flicker-Free 4D Motion Modeling Anchor Relay-based Bidirectional Blending via with Hierarchical Densification,” In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), Jun. 2026. (**Highlight**) [Project page] [ArXiv] [Demo video]
- [2] **S. Kwak**, J. Kim, J. Jeong, W-S. Cheong, J. Oh<sup>†</sup>, M. Kim<sup>†</sup> “MoDec-GS: Global-to-Local Motion Decomposition and Temporal Interval Adjustment for Compact Dynamic 3D Gaussian Splatting,” In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), Jun. 2025. [Project page] [Paper] [Demo video]
- [3] E. An, M. Kim, K. Seo<sup>†</sup>, **S. Kwak**, A. Kim, S. Jung, H. Choo “Tracking-based adaptive temporal resampling for video coding for machines,” IEEE International Conference on Advanced Visual and Signal-Based Systems (AVSS). 2025.
- [4] H. Choi, S. Jeong, **S. Kwak**, S. Jung, J. Ko<sup>†</sup> “Adaptive Image Downscaling for Rate-Accuracy-Latency Optimization of Task-Target Image Compression,” IEEE 6th International Conference on AI Circuits and Systems (AICAS). 2024.
- [5] **S. Kwak**, J. Jeong, J. Kim, G. Lee, W-S. Cheong, M. Kim<sup>†</sup> “A Study on the Effect of Total Variation Regularizer in Voxel Grid-based Radiance Field,” International Conference on 3D Systems and Applications (3DSA) 2023.
- [6] G. Lee, **S. Kwak**, H. Shin, B. Lee, W-S. Cheong “Partial Access using Group-based MPEG Immersive Video Coding Technology,” International Conference on 3D Systems and Applications (3DSA) 2023.
- [7] Y. Lee, S. Kim, K. Yoon<sup>†</sup>, H. Lim, **S. Kwak**, H. Choo “Machine-Attention-based Video Coding for Machines,” IEEE International Conference on Image Processing (ICIP). 2023.
- [8] **S. Kwak**, J. Yun, H. Choo, M. Kim<sup>†</sup> “Feature-Guided Machine-Centric Image Coding for Downstream Tasks,” IEEE International Conference on Multimedia and Expo Workshops (ICMEW). 2023.
- [9] G. Um, **S. Kwak**, J. Yun, W-S. Cheong, J. Seo “A Study on VCM Anchor Generation for Object Segmentation,” International Conference on Information and Communication Technology Convergence (ICTC). 2020.
- [10] **S. Kwak**, J. Yun, W.-S. Cheong, J. Seo “An Improved View Synthesis of Light Field Images for Supporting 6 Degrees-of-Freedom,” The 26th International Display Workshops (IDW 2019), Nov. 2019. - Oral
- [11] **S. Kwak**, J. Yun, W.-S. Cheong, J. Seo “A Study on the Virtual View Synthesis for Omnidirectional Images,” 10th International Conference on 3D system and applications (3DSA 2018), Aug. 2018. - Oral
- [12] **S. Kwak**, J. Yun, H. Lim, N. Hur “On the Spectral Analysis of Discrete-Time Faster-Than-Nyquist Signaling,” IEEE 19th International Conference on Advanced Communication Technology (ICACT), Feb. 2017. - Oral
- [13] M.-S. Baek, **S. Kwak**, Y. Kim, N. Hur “Design and Performance Evaluation of Physical Layer Security Communication System based on Coded FTN with Soft Re-Modulation Technique,” 2017 Future Generation Communication and Networking (FGCN), Nov. 2017.
- [14] M.-S. Baek, J. Yun, **S. Kwak**, H. Lim, Y. Kim, N. Hur “Physical layer security based on coded FTN signaling for premium services in satellite digital broadcasting system,” 2017 IEEE International Conference on Consumer Electronics (ICCE), Jan. 2017.
- [15] M.-S. Baek, Y. Kim, J. Yun, **S. Kwak**, N. Hur, H. Lim “Performance Evaluation of Faster-Than-Nyquist Signaling with BCJR Interference Cancellation Technique in TU-6 Channel Mode,” 2015 7th International Conference on Multimedia, Computer Graphics and Broadcasting (MulGraB), Nov. 2015.

[16] **S. Kwak**, J. So, Y. Sung “An Extended Least Difference Greedy Clique-Cover Algorithm for Index Coding,” 2014 IEEE International Symposium on Information Theory (ISIT), Jul. 2014.

[17] J. So, **S. Kwak**, Y. Sung “Some new results on index coding when the number of data is less than the number of receivers,” 2014 IEEE International Symposium on Information Theory (ISIT), Jul. 2014.

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## DOMESTICS

### Korean Journals and Conferences

[1] **S. Kwak**, S. Jeong, J. Ko, S. Jung, H. Choo “Learned Joint Filter Network for VCM,” *Korean Institute of Broadcast and Media Engineers (KIBME)* Summer Conference 2025.

[2] **S. Kwak**, G. Lee, W-S. Cheong, H. Lee “View Synthesizing and Rendering for Omni-directional Light Field Videos,” *Korean Institute of Broadcast and Media Engineers (KIBME)* Summer Conference 2022.

[3] **S. Kwak**, J. Yun, W-S. Cheong, J. Seo “A Study on 3-Dimensional Warping Technique for Virtual View Synthesis of Light Field Images,” *Korean Institute of Communications and Information Sciences (KICS)* Winter Conference 2019.

[4] **S. Kwak**, J. Yun, G. Yun, W-S. Cheong, J. Seo “A Study on Virtual View Synthesis Technology for Omni-directional Videos,” *Image Processing and Image Understanding (IPIU)* 2018.

[5] **S. Kwak**, J. Jeong, J. Kim, G. Yun, W-S. Cheong, J. Seo “Standardization Trends of VR Media,” *Electronics and Telecommunications Trends* Vol.32, No. 3, 2017.

[6] **S. Kwak**, J. Yun, M. Baek, H. Lim “Performance Evaluation Criterion of FTN-Based Transmission System,” *The Journal of Korean Institute of Communications and Information Sciences* 2016.

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## AWARDS & HONORS

**Outstanding Paper Award** at Korean Institute of Broadcast and Media Engineers Summer Conference 2022

**Outstanding Paper Award** at Korea Information and Communication Society (KICS) Winter Conference 2019

**Outstanding Paper Award** at International Conference on 3D Systems and Applications (3DSA) 2019

**National Science and Technology Scholarship (Four years full tuition)**, Ministry of Science and Technology, Korea (2008 – 2012)

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## PROJECTS

**Spatial Computing Technologies** Jan. 2022 – Present

- Development of Immersive Video Spatial Computing Technology for Ultra-realistic Metaverse Services
- Composition, transmission, synthesizing, and rendering spatial computing technologies for immersive media streaming service based on MPEG Immersive Video (MIV)
- funded by ICT RnD program of MSIP/IITP

**Video Coding for Machines** Jan. 2020 – Present

- Developing video coding technologies optimized for machine analysis
- International standardization activity on MPEG Video Coding for Machine (VCM)
- funded by ICT RD program of MSIP/IITP

**Fundamental Technologies on Light Field** Jan. 2017 – Dec. 2021

- Development of Audio/Video Coding and Light Field Media Fundamental Technologies for Ultra Realistic Tera-media
- Developed fundamental technologies for virtual view synthesis and rendering toward immersive media services supporting 6 degrees-of-freedom to HMD user.
- funded by ICT RnD program of MSIP/IITP

**Faster-Than-Nyquist Signaling** Jan. 2014 – Dec. 2016

- Development of the Advanced Broadcasting Systems based on FTN
- Researched FTN signaling and iterative interference cancellation to improve the spectral efficiency of current broadcasting system.
- funded by ICT RnD program of MSIP/IITP

## PROFESSIONAL ACTIVITIES

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### International Standardization: ISO/IEC JTC1/SC29 MPEG

2019 – Present

- m73774, [VCM] Modification of NNBDP decoding process
- m72245, [VCM] Postfilter network for VCM
- m72243, [VCM] Prefilter network for VCM
- m71305, [VCM] Neural network based post-filter for VCM
- m71304, [VCM] Neural network based pre-filter for VCM
- m69990, [VCM] Learned joint filter network for VCM
- m69085, [VCM] Learned pre-filter network for VCM
- m63676, [VCM] Proposed performance evaluation method for VCM CE1
- m60245, [VCM] Comments on Common Test Conditions and Evaluation Methodology for VCM
- m56653, [VCM] Investigation on feature map channel reordering and compression for object detection
- m55320, [VCM] Application of a super resolution network for up-scaling in VCM anchor generation pipeline
- m54412, [VCM] Some considerations on VCM anchor generation for object segmentation on Cityscapes dataset
- m54409, [MPEG-I Visual] Ray-based blending weight for 6DoF view synthesis
- m48769, [MPEG-I Visual] Improved Triangle Colorization of RVS for Synthesizing Images in ERP format

### Invited talks and Exhibitions

- **Youtube video**, "Immersive 3D video without glasses," *ETRI IT Technology Report*, Aug, 2025. [[link](#)]
- **Exhibition**, "Real-time 3D video synthesis and rendering spatial computing technology," *ETRI Conference*, June, 2025.
- **Invited Talk**, "Novel view synthesis for various types of immersive displays," *Optical Society of Korea Winter Conference*, Dec. 2024.
- **Invited Talk & Exhibition**, "6 Degrees-of-Freedom Immersive Media Technologies," *ETRI Conference*, May 2022.
- **Exhibition**, "Real-time view synthesis and rendering for omni-directional LF videos," *ETRI Communication and Media Technical Exhibition*, Jan, 2022.
- **Invited Talk**, "View synthesis and rendering for Immersive videos," *MPEG New Media Forum Technical Workshop*, Nov. 2021.
- **Invited Talk**, "Novel view synthesis for omni-directional light field videos," *ETRI Media Techday*, Oct. 2020.

### Reviewer

- IEEE Transactions on Multimedia
- IEEE Transactions on Visualization and Computer Graphics
- IEEE Transactions on Circuits and Systems for Video Technology
- ACM Multimedia
- ETRI Journal

## PATENT

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### Granted

- KR 2838985, Method and apparatus for encoding feature map, Jul. 22. 2025
- US 12293567, Feature-map-encoding method and apparatus for encoding and decoding a feature map for a neural network, May. 06. 2025.
- US 12170785, Method and apparatus for adaptive image preprocessing and reconstruction, Dec. 17. 2024.
- US 11706395, Apparatus and method for selecting camera providing input images to synthesize virtual view images, Jul. 18. 2023.
- US 11528461, Method and apparatus for generating virtual viewpoint image, Dec. 12. 2022.

### Applications

- US 19/170459, Method and apparatus for encoding feature map, Apr. 04. 2025.

- US 19/086288, Method and device for viewport-based atlas selection, Mar. 21. 2025.
- KR 2025-0007579, Method and apparatus for tracking-based adaptive temporal resampling for VCM, Jan. 17. 2025.
- KR 2025-0002494, Method and apparatus for representing 3D dynamic scenes based on motion decomposition, Jan. 07. 2025.
- KR 2024-0151557, Method and device for image pre-processing filtering for VCM, Oct. 30. 2024.
- KR 2024-0092940, Method and device of learning based pre-processing filtering for video coding for machine, Jul. 15. 2024.
- KR 2024-0039196, Method and device for viewport-based atlas selection, Mar. 21. 2024.
- KR 2023-0170135, Method and apparatus of rate-adaptive video filtering for machines, Nov. 29. 2023.
- US 18/514150, Method and apparatus for non-uniform super-resolution of image, Nov. 20. 2023.
- KR 2022-0003596, Method and apparatus for image feature vector encoding for machine, Jan. 10. 2022.
- KR 2022-0000334, Method and apparatus for combining warping images based on depth distribution, Jan. 03. 2022.
- KR 2021-0164317, Method for adaptive pre-processing and restoring image for supporting human and machine simultaneously, Nov. 25. 2021.

## EXTRA

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### Technology Transfer

- Omnidirectional Virtual View Synthesizing and Rendering System, transferred to Overay, May 2024. (Contract value: 30M KRW)
- Omnidirectional Virtual View Synthesizing and Rendering System, transferred to HanulSoft, Nov. 2023. (Contract value: 30M KRW)