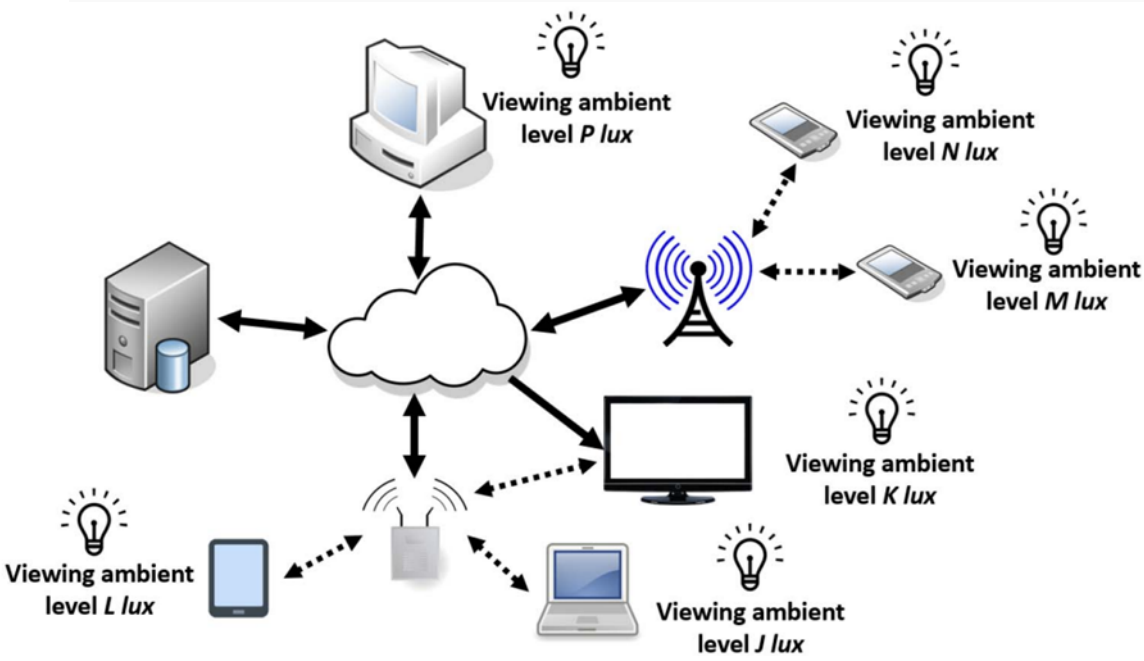
IEEE CONSUMER TECHNOLOGY SOCIETY (CTSOC)

ISSUE: JULY 2022

CTSOC-NCT NEWS ON CONSUMER TECHNOLOGY



An example of a system with different end user devices with different target luminance to dynamically correct picture quality based on creative intent metadata

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EDITOR'S NOTE

On behalf of the Editorial Board of IEEE CTSoc News on Consumer Technology (NCT) editor-in-chief Wen-Huang Cheng and editors, Luca Romeo, Jianlong Fu and Loh Yuen Peng, I am happy to introduce the July issue of the NCT in 2022.

This issue starts with a cover story which shows an adaptive ambient compensation method for High dynamic range (HDR) image to preserve the content providers' creative intent in different ambient light levels and ranges for HDR10+ content using creative intent metadata published in the CTSoc's journal, IEEE Transactions on Consumer Electronics. Extensive visualized results show superior performance of ambient compensation using the proposed method under different ambient levels. The comparison results show that the algorithm can dynamically correct the picture quality based on creative intent metadata and is capable of keeping the creative intent in different ambient conditions.

Next, the feature people provide an interview with the header Mr. Yurii Shchyhol and Deputy Chairman Mr. Oleksandr Potii of the state service of special communications and information protection (SSSCIP) of Ukraine. This interview shows the targets of russian hackers, the types of cyberattack and how SSSCIP is trying to protect and keep cyberspace of Ukraine safe against the widespread cyberattack from Russian hackers after Russian aggression against Ukraine started.
Finally, this issue presents a featured article brought by Prof. Yingsong Li of Anhui University , China, discussing on how to enhance the uniform degree-of-freedom (DOF) and achieve high resolution in direction-of-arrival (DOA) estimation and beamforming. The article proposed sparse array design method based on uniform linear arrays (ULA) to find out a good solution for aforementioned problems, giving a name of ULA fitting scheme for sparse array configurations. The proposed ULA fitting scheme and its variants are promoted for DOA estimation, target recognition and MIMO radar, and outperforms the traditional ULA and existing sparse arrays with low mutual coupling.

We hope you can enjoy your reading!

Editor of NCT
Yafei Hou

ARTICLE TITLE
HDR10+ Adaptive Ambient Compensation Using Creative Intent Metadata

AUTHOR(S)
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JOURNAL TITLE
IEEE TRASACTIONS ON CONSUMER ELECTRONICS

JOURNAL VOLUME AND ISSUE
Volume: 68, Issue: 2

DATE OF THE ARTICLE
MAY 2022

PAGE NUMBERS FOR THE ARTICLE
149 – 160

High dynamic range (HDR) image processing and ambient compensation have been a heated consumer electronic research topic recently. The paper proposes an adaptive ambient compensation method to preserve the content providers' creative intent in different ambient light levels and ranges for HDR10+ content. It adapts to the ambient light levels as well as the scene luminance percentile information based creative intent metadata. Only limited number of percentile value are needed to present the content tonality for the compensation and consume very small bandwidth. Multiple sections of tone mapping curves with multiple adjustment points along explicit Bezier curve for more flexible tone mapping curve control is adopted. Extensive visualized results show superior performance of ambient compensation using the proposed method under different ambient levels. A psychophysical experiments based ambient light compensation development is also discussed for the tuning process to keep the creative intent. The comparison results show that the algorithm can dynamically correct the picture quality based on creative intent metadata and is capable of keeping the creative intent in different ambient conditions.

INTERVIEW WITH THE LEADERSHIP OF THE STATE SERVICE OF SPECIAL COMMUNICATIONS AND INFORMATION PROTECTION OF UKRAINE

The State Service of Special Communications and Information Protection of Ukraine (SSSCIP) was established on February 23, 2006. The SSSCIP is a specialized central executive authority for special communication and information security, a defense and security agency being the principal actor in the national cybersecurity system. It coordinates the activities of cybersecurity actors in the field of cyber defence and administers communication.

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Yurii Shchyhol
Head of the State Service of Special Communications and Information Protection of Ukraine

Oleksandr Potii
Deputy Chairman of the State Service of Special Communications and Information Protection of Ukraine

Russian aggression against Ukraine is going on, Russia keeps violating international law by waging unlawful attacks on land, at sea, in the air and in cyberspace.

Russian hackers do not seem to be curtailing their activity. Instead, they are still trying to attack Ukrainian infrastructure and even descending to civilian targets.

The most widespread cyberattack methods are infiltration into information systems and malware distribution. Yet, scammers' attempts to mislead the people have also increased substantially since the beginning of the full-scale invasion. They swindle banking card data under the guise of payments from various Ukrainian and foreign public agencies to withdraw money from those cards

Top sectors targeted by russian hackers

- Government and local authorities
- Security and defense
- Energy sector
- Financial sector
- Commercial sector
- Telecommunication sector and developers
- Transport sector

The most widespread types of cyberattack

- Malicious code
- Intrusion
- Intrusion attempts
- Violation of information properties
- Accessibility disruption
- Dangerous (abusive) content
- Known vulnerability
- Scam

All the cyberattack methods used by Russians are well known, there are no high-complexity or hardly identifiable ones among the latest cyber incidents. Phishing accounts for around 60 to 70% of Russian hacking attacks on Ukraine's public sector, recorded by the CERT-UA

Phishing emails help russian hackers steal user account data and use compromised accounts to distribute spyware or destruction software. Their proficiency in creating phishing emails has reached a high level over the years of regular cyberattacks on Ukrainian infrastructure.

This is why protection of account credentials is becoming an increasingly pressing issue when it comes to public officials and critical infrastructure personnel. This concerns not only Ukraine, but the entire world as well, because information security experts are already detecting intensification of russian hackers' activity all around the world.

Current Russian war against Ukraine has given mature democracies some extra evidence that it is no one but Russia behind aggressive attacks on critical infrastructure all over the world

Attacks on energy infrastructure never stop since the Ukrainian energy system was

disconnected from Russia and synchronized with the EU. Russian security services are not even trying to conceal their illegal interference. Ukrenergo, Ukraine's transmission operator, has reveals the facts of scanning their systems by the russian Federal Guard Service and SC Roscosmos. Russian group Killnet claims to be responsible for the latest overt attacks on Lithuania, a NATO member.

Russian cyber troops show that their actions are tightly coordinated with land and missile assaults. On June 22, Russian troops assaulted Mykolaiv city, the administrative center of a southern region of Ukraine, bordering currently occupied Kherson region. A total of seven missiles hit the city.

Roughly at the same time, Mykolaiv region suffered a cyberattack. Russian security services attacked the email server of the Mykolaiv Region State Administration on the very next day, June.

Because of that, they have gained access to the mailbox of the regional press center. Russian hackers coordinate their targets with attacks on the fuel and energy sector as well. Due to the invasion, Ukraine has found itself cut off from usual fuel supply and petroleum refineries and fuel depots have become permanent targets for missile assaults. To make gas and diesel fuel imports for Ukrainian road transport even more difficult, hackers have attacked online resources of the National Transport Safety Agency of Ukraine.

A well-coordinated DDoS attack by a russian hacking group on the dsbt.gov.ua web addresses and the SHLIAKH system servers was launched on June 28. As this system is used to manage the national border crossing, it has affected road traffic speed at Ukraine's international checkpoints. The traffic has been hindered for six hours.

The response to such attacks should be collective, joint and united. A collective security policy is the only way for all of us to defend ourselves efficiently

This approach is already being implemented at the top level. It is stated in NATO Strategic Concept 2022 https://www.nato.int/nato_static_fl2014/assets/pdf/2022/6/pdf/290622-strategic-concept.pdf
and the G7 Leaders' Final Communiqué https://www.consilium.europa.eu/media/57555/2022-06-28-leaders-communique-data.pdf

Sharing threat indicators and joint training exercises of cyber defense specialists working for the public sector are the two primary aspects of the collective cybersecurity system. Deeper integration of Ukraine into the CCDCOE will contribute to setting this system up. In late May, the Ukrainian delegation participated in a meeting of the NATO Cooperative Cyber Defence Centre of Excellence for the first time.

Joining the CCDCOE will be an important step for our country towards the enhanced international cooperation
in cybersecurity and cyber defense, as well as towards NATO membership for Ukraine. Granting the EU candidate status to Ukraine will also facilitate cooperation with relevant European institutions.

New methods of cyber defense are being shaped here in Ukraine through successful resistance to attacks. The key elements of cyber defense are sufficient funding at the national level as well as at private companies managing critical infrastructure, efficient use of these funds, cyber hygiene at all levels, and extensive international cooperation

Despite the ongoing war, Ukrainian Government has granted extra UAH 1.2

billion to the Administration of the State Service of Special Communications and Information Protection. These funds will be allocated for the purpose of further construction of the National Information Resource Backup Center and cyber defense, such as software update and backups of the national critical public information resources.

The SSSCIP stands on the frontline in this cyberwar, defending the national IT infrastructure. The SSSCIP Head Yurii Shchyhol has presented his analysis of the firs lessons learnt in the ongoing cyberwar to the global expert community: https://www.atlanticcouncil.org/blogs/ukrainealert/vladimir-putins-ukraine-invasion-is-the-worlds-first-full-scale-cyberwar/

Conclusion

In addition, we'd like to remind that the SSSCIP State Cybersecurity Centre and the Computer Emergency Response Team of Ukraine
(CERT-UA), jointly with the teams of the best Ukrainian cybersecurity companies and the world's major producers of solutions provide comprehensive assistance in establishing multiple-tiered cyber defense systems of the IT infrastructure for institutions and organizations, irrespective of ownership.

All of us must stay resilient to external challenges, continue providing services to people and ensure the functioning of the business and the economy in whole. Please, send your requests to our official e-mail address
cert@cert.gov.ua
and we will provide you with targeted assistance in defense against cyber attacks, security monitoring, migration to cloud environments, deployment of state-of-the-art systems to defend your workstations and servers against cyber-attacks, etc.

SPARSE ARRAY DESIGNS BASED ON ULA FITTING: PRINCIPLE AND APPLICATIONS

Yingsong Li, Wanlu Shi
Anhui University, China; Harbin Engineering University, China

Yingsong Li is a full professor of Key Laboratory of Intelligent Computing and Signal Processing, Ministry of Education of Anhui University. His research focuses Signal/image processing, Array and antenna designs, MIMO radars, meta-surface designs for radar and communications and EMC.

Wanlu Shi is a Ph.D. student in Harbin Engineering University. Her research focuses on Sparse array design, DOA estimation and Beamforming.

Introduction:

Sparse array has been considered for enhancing the uniform degree-of-freedom (DOF) and achieving high resolution in direction-of-arrival (DOA) estimation and beamforming. We proposed sparse array design method based on uniform linear arrays (ULA) to find out a good solution for aforementioned problems, giving a name of ULA fitting scheme for sparse array configurations. The proposed ULA fitting scheme and its variants are promoted for DOA estimation, target recognition and MIMO radar. The results obtained from the experiments and simulations verified that the proposed schemes outperform the traditional ULA and existing sparse arrays with low mutual coupling.

1. Principle of the proposed ULA fitting scheme

As we know, the traditional array signal processing [1] based on subspace technique like MUltiple SIgnal Classification (MUSIC) [2] can detect less targets than the total number of sensors for DOA estimation, which also requires an inter-element spacing of maximum of half-wavelength to avoid aliasing. However, the mutual coupling will be high since the array element are setting very near. For the sparse array developments, our goal is to recognize more targets with less array elements in comparison with the traditional ULAs. Then, difference coarray (DCA) was reported to achieve high degree-of-freedom (DOF) [3]. Based on DCA concept, nested and coprime arrays [4-5] were presented for developing different sparse array structures, which can provide closed-form expression and good DCAs.

Although many sparse arrays have been proposed and discussed for many applications, there is no general method for sparse array constructions.

Our proposed method uses a polynomial model to analyze DCA and establish a relationship between positions of sensors and weight function based on a concatenation of a series of ULAs, which is denoted as ULA fitting scheme [6-9]. As a result, the proposed ULA fitting scheme can be used for constructing various sparse arrays with closed-form expression and DCA analysis. Additionally, a pseudo polynomial function was constructed to design high performance sparse arrays. In the ULA fitting scheme, the three different layers, namely the base layer (BL) that includes several sub-ULAs, the transform layer (TL) that has different forms and the additional layers (ALs) that are to complement weights. The base layer always has sub-ULA(s) that has same structure(s) to construct a dense coarray following the transform layer periodically, and the transform layer is to provide a transfer period including the transforming times, and additional layer together with base layer pad each period to get a tense coarray. The work principle of the sparse array (SA) design is illustrated in Fig.1. In this example, there are six sub-ULAs, where Sub-ULA3 is used as the transform layer, Sub-ULA1, Sub-ULA4, and Sub-ULA6 are adopted as the base layer, while Sub-ULA2, and Sub-ULA5 are used as the additional layer. Using the ULA fitting schemes in [6-9], the SA is constructed to obtain a transform range in the DCA domain. Herein, the self-difference coarrays (SDCAs) of the transfer sub-ULA provides the periodic frame to be filled by the inter-difference coarrays (IDCAs) related to the transfer sub-ULA.

2. Example of an SA using ULA fitting

Based on the ULA fitting (UF) scheme, an example for SA design using 5 base layer (BL) is proposed and used for DOA estimation, which is denoted as UF-BL5. The UF-BL5 structure using the ULA fitting is presented in [10] to implement DOA estimation, and the obtained performance compared with existing SAs is presented in Fig. 2.

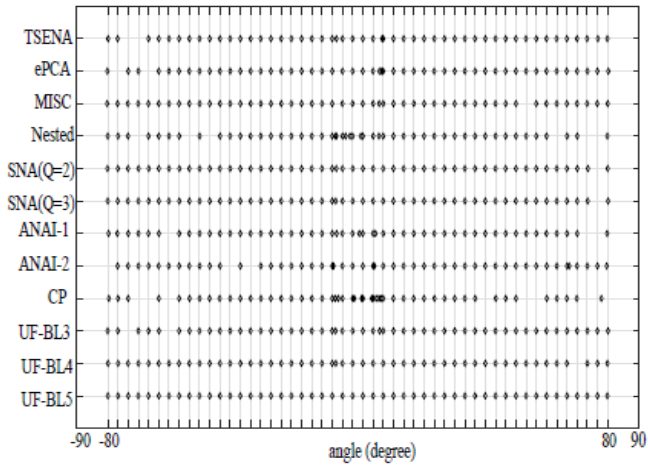

Fig. 2: DOA estimation with different SAs [10]

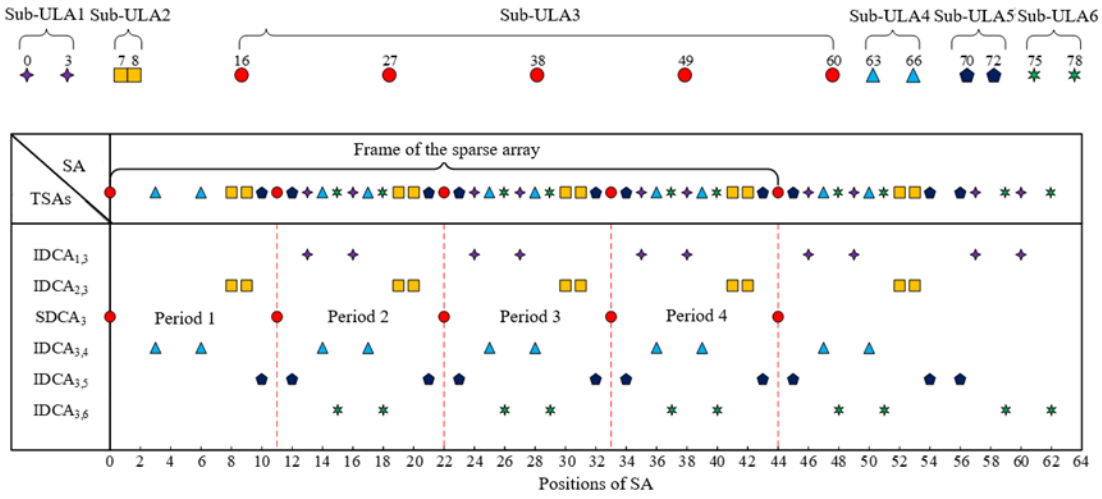

Fig.1 Illustration for SA design using ULA fitting scheme

Herein, UF-BL3 and UF-BL4 are SAs using ULA fitting with 3 and 4 BLs, respectively, and their performance is compared with Two side extended nested array (TESNA) [11], Extended padded coprime array (ePCA) [12], Maximum inter-element spacing constraint (MISC) [13], Nested arrays (Nested) [4], Super nested array (SNA) [14], Augmented nested arrays (ANA-1 and ANA-2) [15], Co-prime arrays (CP) [5].

3. Data processing for DOA estimation in practical engineering

To promote the application of the SA design using ULA fitting and discuss its performance, an experiment is carried out in the South China Sea. The receiving array has 80 uniformly located hydrophones, where the interspace is 6.25 meters and the deployment depth is 120 meters. The observed space is [−90◦, 90◦] and the direction of the receiving ship (fixed above the receiving array) is 65◦, while some other ships are working around. The analyzed frequency ranges from 50 to 120Hz with an observation duration of 500 seconds. In the data analysis, only 15 hydrophones are used for the SAs. The performance for various sparse arrays for analyzing the obtained data is shown in Fig.3.

From the results, we can see that the proposed adjoint transfer layer (ATL) with 1 BL and 2BL are denoted as ATLI-1BL and ATLI-2BL that have better resolution and tracking performance than most existing SAs.

4. UF scheme for MIMO radar

Also, to make the sparse array suitable for practical applications, the ULA fitting scheme is used for developing MIMO radar with high uniform DOF and low mutual coupling. In the design, the transmit array has a DCA with holes is considered. The devised sparse MIMO arrays maintain the merit of UF principle and they have closed-form expressions. Herein, an improved ULA fitting scheme proposed in [17] and an SA with high uniform DOF is designed accordingly using the adjoint transfer layer with an increasing number of sensors and 1-base layer (ATLI-1BL). For the MIMO radar, an SA developed using ULA fitting having 3 BLs, which is mentioned as UF-3BL is selected as the transmit array and ATLI-1BL is chosen as the receive array. In this case, the devised MIMO radar is represented as UF3-ATLI1BL MIMO, where 11 transmitters and 7 receivers are used for the MIMO radar. Also, we have a unit element spacing for the phototype array (PA). The design procedure of the UF3-ATLI1BL MIMO radar is presented in Fig.4.

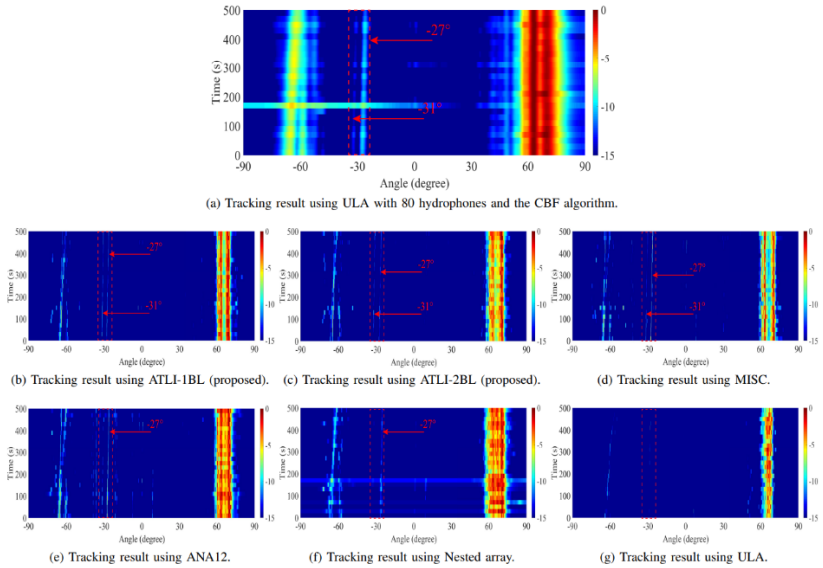

Fig.3 Comparisons of tracking results with different sparse arrays [9]

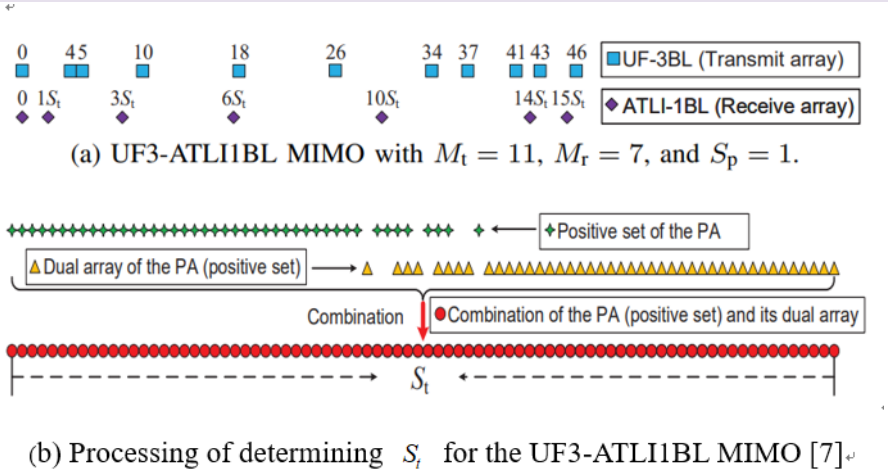

Fig. 4 Illustration of the UF3-ATLI1BL MIMO (with 18 physical sensors) and the design process

5. Conclusion

ULA fitting sparse array is a more general method for developing sparse arrays to achieve high degree-of-freedom and low coupling leakage. Form the investigation, the ULA fitting scheme can be used for MIMO radar, DOA. In the future, the ULA fitting will be used for beamforming and 2-D applications.

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