feature in the metallicity between cEw and cEw/o can suggest that two different scenarios can be provided in the formation of cEs. cEw would be the remnant cores of the massive progenitor galaxies that their outer parts have been tidally stripped by massive neighbor galaxies (i.e., nurture origin). On the other hand, cEw/o are likely to be faint-end of early-type galaxies maintaining in-situ evolution (i.e., nurture origin).

[포 GC-18] Deep survey using deep learning: generative adversarial network

Youngjun Park[1], Yun-Young Choi[2], Yong-Jae Moon[1,2], Eunsu Park[1], Beomdu Lim[1] and Taeyoung Kim[1,3]
[1]School of Space Research, Kyung Hee University, Yongin 17104, Korea
[2]Department of Astronomy and Space Science, Kyung Hee University, Yongin 17104, Korea
[3]Department of Research and Development, InSpace Co., Ltd

There are a huge number of faint objects that have not been observed due to the lack of large and deep surveys. In this study, we demonstrate that a deep learning approach can produce a better quality deep image from a single pass imaging so that could be an alternative of conventional image stacking technique or the expensive large and deep surveys.

Using data from the Sloan Digital Sky Survey (SDSS) stripe 82 which provide repeatedly scanned imaging data, a training data set is constructed: g-, r-, and i-band images of single pass data as an input and r-band co-added image as a target. Out of 151 SDSS fields that have been repeatedly scanned 34 times, 120 fields were used for training and 31 fields for validation. The size of a frame selected for the training is 1k by 1k pixel scale. To avoid possible problems caused by the small number of training sets, frames are randomly selected within that field each iteration of training.

Every 5000 iterations of training, the performance were evaluated with RMSE, peak signal-to-noise ratio which is given on logarithmic scale, structural symmetry index (SSIM) and difference in SSIM. We continued the training until a GAN model with the best performance is found. We apply the best GAN-model to NGC0941 located in SDSS stripe 82. By comparing the radial surface brightness and photometry error of images, we found the possibility that this technique could generate a deep image with statistics close to the stacked image from a single-pass image.

천문우주관측기술

[포 AT-01] Control software for temperature sensors in astronomical devices using GMT SDK 1.6.0

Changgon Kim[1], Jimin Han[1], Martí Pi[2], Josema Filgueira[2], Marianne Cox[2], Alfonso Román[2], Jordi Molgó[2], William Schoenell[2], Pierre Kurkdjian[2], Tae-Geun Ji[3], Hye-In Lee[3], Soojong Pak[3].
Dept. of Astronomy and Space Science, Kyung Hee University, [2]Giant Magellan Telescope Organization. [3]School of Space Research, Kyung Hee University.

The temperature control of a scientific device is essential because extreme temperature conditions can cause hazard issues for the operation. We developed a software which can interact with the temperature sensor using the GMT SDK(Giant Magellan Telescope Software Development Kit) version 1.6.0. The temperature sensor interacts with the EtherCAT(Ethernet for Control Automation Technology) slave via the hardware adapter, sending and receiving data by a packet. The PDO(Process Data Object) and SDO(Service Data Object), which are the packet interacts with each EtherCAT slave, are defined on the TwinCAT program that enables the real-time control of the devices. The user can receive data from the device via grs(GMT Runtime System) tools and log service. Besides, we programmed the software to print an alert message on the log when the temperature condition changes to certain conditions.

[포 AT-02] Constraining the Evolution of Epoch of Reionization by Deep-Learning the 21-cm Differential Brightness Temperature

Yungi Kwon[1], Sungwook E. Hong[2]
[1]Department of Physics, University of Seoul,
[2]Natural Science Research Institute, University of Seoul

We develop a novel technique that can constrain the evolutionary track of the epoch of reionization (EoR) by applying the convolutional neural network (CNN) to the 21-cm differential brightness temperature. We use 21cmFAST, a fast semi-numerical cosmological 21-cm signal simulator, to produce mock 21-cm map between z=6-13. We design a CNN architecture that predicts the volume-averaged neutral hydrogen fraction from the given 21-cm map. The estimated neutral fraction has a good agreement with its truth value even after smoothing the 21-cm map with somewhat realistic choices of beam size and the

frequency bandwidth of the Square Kilometre Array (SKA). Our technique could be further utilized to denoise the 21-cm map or constrain the properties of the radiation sources.

[포 AT-03] Alignment of Schwarzchild-Chang Off-axis Telescope with a Shack-Hartmann Wavefront Sensor and Sensitivity Table Method

Sunwoo Lee[1], Woojin Park[1], Yunjong Kim[2], Sanghyuk Kim[2], Seunghyuk Chang[3], Byeongjoon Jeong[4], Geon Hee Kim[4] and Soojong Pak[1]
[1]School of Space Research and Institute of Natural Science, Kyung Hee University, [2]Optical Astronomical Technology Group, Korea Astronomy and Space Science Institute, [3]Center for Integrated Smart Sensors, Korea Advanced Institute of Science and Technology (KAIST), [4]Korea Science Basic Institute

The Schwarzchild-Chang telescope is a confocal off-axis two mirror telescope with D = 50 mm, F = 100 mm and FOV = 8 ° × 8 °. Unlike common off-axis telescopes, the mirrors of the Schwarzchild-Chang telescope share their focal points to remove the linear astigmatism. In this poster, we show the alignment process of the Schwarzchild-Chang telescope with wavefront measurement and the sensitivity table method. Wavefront is measured using the Shack-Hartmann sensor, and Zernike polynomials are obtained from measured wavefront. Sensitivity table method is to calculate alignment errors from the Zernike coefficients. As a result, we evaluate tilt, decenter, and despace of each mirror of linear astigmatism-free con-focal off-axis system.

[포 AT-04] Maemi Dual Field Telescope System (MDFTS) : New survey facility of Kyung Hee Astronomical Observatory

Hojae Ahn[1], Na Yeon Kim[1], Dohoon Kim[1], Soojong Pak[1], and Myungshin Im[2]
[1]Department of Astronomy Space Science, Kyung Hee University, [2]Center for the Exploration of the Origin of the Universe, Department of Physics and Astronomy, Seoul National University

We introduce Maemi Dual Field Telescope System (MDFTS) which is newly installed at Kyung Hee Astronomical Observatory (KHAO). MDFTS consists of two telescope tubes (40cm and 10cm), whose observing fields are aligned with different field of view, 15' x 11' and 83' x 63' respectively. We present the specification of instruments (telescope, mount, camera, and filter system) and the observation environment of KHAO. We expect that MDFTS can be used for transient survey e.g. Intensive Monitoring Survey of Nearby Galaxies (IMSNG). Based on observations conducted so far, the limiting magnitude of 40cm telescope in B-band is B_lim ~ 16 mag at 5-σ detection with 150 seconds total integration time under dark and clear observing condition. Also the integrated observing software for MDFTS, KAOS40 is now under developing.

[포 AT-05] Design of control software for GMACS (Giant Magellan Telescope Multi-Object Astronomical and Cosmological Spectrograph)

Hye-In Lee1, Tae-Geun Ji1, Soojong Pak1, Erika Cook2, Cynthia Froning2, Luke M. Schmidt2, Jennifer L. Marshall2, Darren L. DePoy2
[1]School of Space Research, Kyung Hee University
[2]Department of Physics & Astronomy, Texas A&M University

GMACS is one of the first light instruments for the Giant Magellan Telescope (GMT). The development of GMACS control software follows Agile software development process, and the design of the software is based on the Unified Model Language (UML). In this poster, we present the architecture of the GMACS software and the development processes. As an example of the software development, we show the software of the Slit Mask Exchange Mechanism Prototype (SMEM-P) which is part of the GMACS Device Control Package (DCP).