xDR Challenge 2025
~Smartphone with Navigation Robot~

IPIN 2025 Competition Track 5: Smartphone with Navigation Robot (offsite-online)

xDR Challenge2025
~Smartphone with Navigation Robot~

xDR Challenge is a series of indoor localization competition by PDR benchmark standardization committee mainly focused on integrated indoor localization methods with dead-reckoning. xDR Challenge 2025 will be held as an official competition track of IPIN 2025 (**Track 5**). Our track is categorized as "offsite, online" track, which means that the competitors are asked to submit estimated trajectories of targets in certein time limit in real-time. Application scenario of this year's competition is navigation of people with visual impairment in a facility by cooperating a smartphone and a navigation robot (AI Suitcase). Target field of this year's competition is a national museum and the targets of localization are pedestrian walking in the field with a navigation robot. The pedestrian (we call "target") moves with/without a navigation robot in a museum floor and views exhibits with approximately 15-minute mock tours. The targets in this competition include people with/without visual impairment. The target wears a smartphone on the chest with visual-inertial odometry system. The smartphone communicates with the navigation robot, which is equipped with UWB for ranging with the smartphone, LiDAR and IMU for self-localization. The competitors are asked to estimate trajectories of the target using IMU, VIO, UWB, and location of the navigation robot. We will evaluated the estimated trajectories of the target by utilizing multi-faceted evaluation metrics.

Definition of data and trials used in this track

Trial dataset: Dataset provided for testing and tuning the localization and tracking methods (LTM) before the actual scoring trial. The trial dataset is small subset of the dataset and provided with ground-truth data.

Scoring dataset: Dataset provided for actual benchmarking. The scoring dataset is provided without ground-truth data. The benchmarking participants are asked to submit the result of LTM by processing the scoring dataset. In this competition, the scoring dataset may includes unseen subjects and/or paths

* These are based on definitions in ISO/IEC DIS 21134 (Information technology — Computer graphics, image processing and environmental data representation — Benchmarking of integrated indoor localization and tracking methods using dead reckoning)

Testing trials: Set of data distribution and result submission through the EvaAAL competition

Supporting Communities

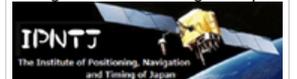PDR Benchmark Standardization Committee

Human Activity Sensing Consortium

Human machine harmonization system consortium

The Institute of Positioning, Navigation and Timing of Japan

Consortium for Advanced Assistive Mobility Platform

xDR Challenge series

Testing trials: Set of data distribution and result submission through the EvaalAPI on competition organizer's servers and are reloadable. Competitors can run them as many times as they like to evaluate and fine-tune their system as well as to get used to the EvaalAPI.These trials use some data from the trial dataset.

Scoring trials: Set of data distribution and result submission through the EvaalAPI on competition organizer's servers and are only available at specific times during the competition production. These trials use data from the scoring dataset.

(URL:)https://unit.aist.go.jp/rihsa/xDR-Challenge-2025/index.html

Important Dates

Technical annexes published (this page)	12 May, 2025
Test trials publish	June, 2025
Hands-on tutorial in Robomech 2025	4 June, 2025 (video will be provided for competitors)
Application closes	31 August, 2025
Competition	8 - 10 September, 2025 (To be decided)
Winner proclamation:	18 September, 2025 (During IPIN Conference)

★ Overview

xDR Challenge 2025 ~Smartphone with Navigation Robot~ (Hereafter referred to as xDR Challenge 2025) will be held as a sequel competition of PDR/xDR Challenge series which had been hosted by PDR Benchmark standardization committee. As in previous years' competitions, the xDR Challenge 2025 will be held as an official competition tracks of the IPIN conference. There are three categories of tracks in IPIN 2025 competition. Our track is categorized as an **"Off-site, On-line"** track.

The **off-site competition** means that
- Competition organizers have conducted measurement and prepare dataset for the competition, and
- The dataset measured will be provided to competitors, and
- The competitors are required to estimate the targets movement by applying their own algorithm and submit the estimated results.
The **on-line competition** means that
- the competitors are required to submit the results in real-time, but to submit in certain (longer) time limit, and
- the competitors cannot obtain whole data of each sequence for applying global optimization while constraining with provided information.

The datasets of our track consists of sensor data required for the VIO and/or PDR-based indoor localization. The data are measured in the museum with mock tours with participants. We measured pedestrian movement by using iOS device and a navigation robot. We collected sensor (gyro, accelerometer, magnets sensor) data at best-effort basis as well as results of the visual-inertial odometry (VIO) by ARKit and the UWB range and AoA signals from the navigation robot's UWB tag. To limit complexity of the competition, the participants will receive pre-computed VIO results (location and orientation at a frame), navigation robot's location and orientation (no LiDAR data from navigation robot) and UWB ranging and AoA (thus no CIR is distributed).
Similar to the previous PDR/xDR Challenges, submitted trajectories will be evaluated by multi-faced evaluation metrics. The ground truth was obtained by a following robot that measures its location by the LiDAR & IMU, and AR marker equipped on the neck of the participant by the camera. The detailed evaluation metrics will be announced at a later date.

xDR Challenge 2025 will be conducted closely together with other tracks of the IPIN competitions

under a common schedule. We also adopt common tool named EvAAL API for sharing dataset and receiving results. As aligned with other tracks, real competition will be conducted at a day in 8 - 10 September 2025. We will provide test dataset in same format with the real dataset for allowing the competitors to prepare and adjust localization algorithm/systems before the real competition.

We look forward to your participation!

★ Competition Details

To be announced.

★ Dataset

To be announced.

★ How to Participate

■ Step1 Request for Trial Dataset
If potential competitors have an interest in our competition, please register in the data request form (to be opened in June). We will provide you the trial dataset after we confirm your registration.

■ Step2 Downloading Trial Dataset
We will provide link to the trial dataset for those who completed the request for data form. You can download the dataset with provided ID and password. Note that the organizers will manally check the request form contents so it may take a few days to send the access information. After downloading the sample data, the competitor can start testing trials.

■ Step3 Application of the Competition
If you decide to join the competition, please register final admission in IPIN Competition's official application form. The competitors are required to provide short and long descriptions of the system

■ Step4 Payment of subscription fee
In addition to the application, the competitors are required to pay the registration fee. The detail of the payment will be announced later.

■ Step5 Scoring trial
On a track-specific day during the second week of September, the competitors are required to join the scoring trial. We will provide unreferenced data for scoring trial through EvAAL API. Competitors will be asked to call the EvAAL API to get sensor data and submit estimated location in real-time.

■ Step6 Announcement of the results
The result of the xDR Challenge 2025 will be announced during the IPIN 2025 conference

★ Dataset

To be released in June.
The detail of the dataset and an example of estimation method are described in [S. Ogiso et al, IEEE/ION PLANS 2025]. If you use this dataset, please cite this paper to reference the dataset detail.

★ Reference

- Satoki Ogiso, Daisuke Sato, Ryosuke Ichikari, Takahiro Miura, Masakatsu Kourogi, Takashi Okuma, Takeshi Kurata, Takeshi Tanabe : A Method to Estimate User Position and Orientation Based on Relative Position Measurement Between a Navigation Robot and a Smartphone, IEEE/ION PLANS 2025.[paper][slides]
- Takuto Yoshida, Katsuhiko Kaji, Satoki Ogiso, Ryosuke Ichikari, Hideaki Uchiyama, Takeshi Kurata, and Nobuo Kawaguchi: A Survey of Ground Truth Measurement Systems for Indoor Positioning, Journal of Information Processing, 2023.[paper]
- Francesco Potorti, et. al.: Off-line Evaluation of Indoor Positioning Systems in Different Scenarios: The Experiences from IPIN 2020 Competition, IEEE Sensors Journal,2021
- Takeshi Kurata, Takashi Maehata, Hidehito Hashimoto, Naohiro Tada, Ryosuke Ichikari, Hideki Aso, and Yoshinori Ito: IoH Technologies into Indoor Manufacturing Sites,　Proceedings of Advances in

Production Management Systems Conference, 2019

- Ryosuke Ichikari, Katsuhiko Kaji, Ryo Shimomura, Masakatsu Kourogi, Takashi Okuma, and Takeshi Kurata: Off-Site Indoor Localization Competitions Based on Measured Data in a Warehouse, Sensors, vol. 19, issue 4, article 763, 2019.
- Takeshi Kurata, Ryosuke Ichikari, Ryo Shimomura, Katsuhiko Kaji, Takashi Okuma, and Masakatsu Kourogi: Making Pier Data Broader and Deeper: PDR Challenge and Virtual Mapping Party, MobiCASE 2018 (9th EAI International Conference on Mobile Computing, Applications and Services), 2018.
- Masakatsu Kourogi and Tomohiro Fukuhara: Case studies of IPIN services in Japan: Advanced trials and implementations in service and manufacturing fields in special session "Value Creation in LBS (Location-Based Services)", IPIN 2017.

★ Important_Links

- IPIN 2025
- IPIN Competition

★ Organizing Committee

- General Co-Chair: Satoki Ogiso, Ph.D., AIST, Japan
- General Co-Chair: Ryosuke Ichikari, Ph.D., AIST, Japan
- Dataset & Evaluation Chair: Akihiro Sato, Ph.D., AIST, Japan
- International Liaison Co-Chair, Antonio Ramon Jimenez Ruiz, Ph.D., CSIC-UPM, Spain,
- International Liaison Co-Chair, Soyeon Lee, Ph.D., ETRI, Republic of Korea
- Industrial Liaison Chair, Takeshi Kurata, Ph.D., AIST & Univ. of Tsukuba, Japan

★ Acknowledgment

★ Abbreviations

LTM : Localization and tracking methods

xDR : x (pedestrian / vehicle) dead reckoning

PDR : pedestrian dead reckoning

IMU : inertial masurement unit

LiDAR : light detection and ranging

VIO : visual-inertial odometry

BLE : Bluetooth low energy

UWB : ultra-wide band

AoA : Angle of Arrival

★ Contact

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