

WAAM-ViD

The Wire Arc Additive Manufacturing Video Dataset (WAAM-ViD) is a dataset designed for multi-angle melt pool dimension analysis in WAAM. It contains 110 videos recorded from five different orientations (as shown in Fig. 1), each averaging 26.5 seconds in duration and captured at 25–30 frames per second. The videos were filmed using two types of cameras: a passive camera ($n = 80$) and an active laser-illumination camera ($n = 30$). In addition to the videos, the dataset includes detailed metadata such as the camera matrix, distortion coefficients, rotation matrix, translation vector, presence of external lighting, arc current, travel speed, and weld seam dimensions. A subset of annotated frames is provided for training and testing the DeepLabv3 model used for melt pool segmentation. All metadata are also included.

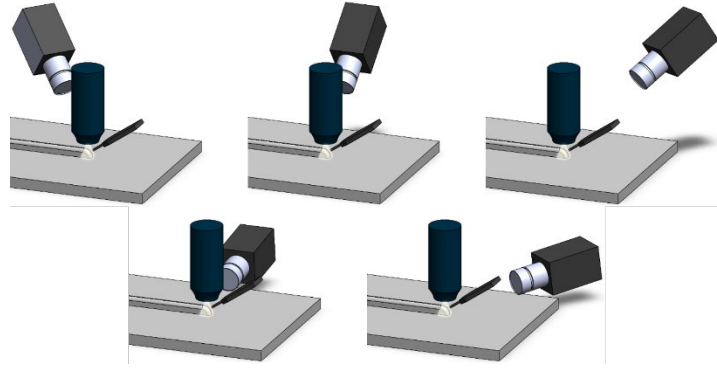


Figure 1: Camera orientations for the videos.

System Setup

Experiments were conducted using a computer numerical control (CNC) machine-based WAAM system with an ER70S-6 steel wire (diameter: 1.2 mm) and plasma transferred arc DED-based WAAM. Table below lists the WAAM parameters:

Table 1: List of WAAM parameters.

Parameters	Value
Shielding gas	100% Argon
Gas flow rate	8 L/min
Plasma gas flow rate	0.8 L/min
Travel speed	2.5 - 2.7 mm/s
Stand-off distance	8 mm
Wire height	1 mm
Wire diameter	1.2 mm
Wire material	Steel (ER70S-6)
Arc current	200 A

All videos were recorded using the Xiris XVC-1000 and CAVITAR C400-H welding cameras. The Xiris XVC-1000 is a standard welding camera, while the CAVITAR C400-H is a laser-illuminated active welding camera. Additionally, weld bead dimensions were obtained using the Micro-Epsilon optoNCDT 2300 laser profile sensor.

Annotated Data

Annotations were independently performed by two raters, with final confirmation by a senior expert with over 10 years of experience in additive manufacturing and WAAM. Segmentation ground truth was generated using RoboFlow, where the RoboFlow-v3 segmentation model was employed for initial annotations. The annotated data are located in the `Labelled_Frames` folder, which is divided into `Train` and `Test` subfolders. The `Train` folder contains five subfolders, each corresponding to a cycle of active learning, with a total of 3,024 annotated frames. The `Test` folder contains 1,650 annotated ground truth frames.

Metadata

The WAAM-ViD dataset is provided with metadata in the form of a csv file. This file contains the following headers: `Video_filepath`, `Labelled`, `Camera_Matrix`, `Distortion_Coefficients`, `Rotation_Matrix`, `Translation_Vector`, `External_Light`, `Travel_Speed`, `Current`, and `Width`.

Video_filepath (Column 1)

This column contains the file path to the video corresponding to each row of data. The last 30 videos in the dataset were recorded using the active camera.

Labelled (Column 2)

This column contains information whether the video has labelled segmentation mask, represented as a boolean.

Camera Coefficients (Columns 2 – 5)

For each video, a reference image was captured using a 6×6 mm checkerboard, with its corners manually annotated. Camera calibration coefficients were then computed using OpenCV in Python, resulting in the following data: `Camera_Matrix`, `Distortion_Coefficients`, `Rotation_Matrix`, and `Translation_Vector`. Each of these matrices was flattened into a list using Pandas to facilitate writing the data to a CSV file.

Physical Parameters (Columns 7 -9)

During the recording of the dataset, physical parameters were varied to increase the diversity of the data. For each camera angle, approximately half of the videos were recorded with an external light source, as indicated by the `External_Light` column. In some recordings, the travel speed of the welding arm was adjusted between 2.5 mm/s and 2.7 mm/s, recorded under the `Travel_Speed` column. The arc current was recorded in the `Current` column.

Width (Column 10)

After each weld was completed, the width of the weld bead was measured and temporally aligned with each video frame, resulting in a list of width values matching the total number of frames in the corresponding video. If the width could not be recorded for a particular frame, the value is represented as `nan`.