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Laboratorium Zaawansowanej Analizy Obrazu, Wideo i Ruchu

Ćwiczenie nr: 1 Temat: Kalibracja kamer

Sekcja: IGT

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Zadanie 1

```
if __name__ == "__main__":
    from zaowr_polsl_kisiel import (
        stereo_calibration,
        stereo_rectify,
        are_params_valid,
    )

    # Directories for calibration images
    left_camera_dir = r"Dataset/Chessboard/Stereo 2/cam1"
    right_camera_dir = r"Dataset/Chessboard/Stereo 2/cam3"

    # Paths for saved calibration parameter files
    params_left_path = "calibration_params/calibration_params_left.json"
    params_right_path = "calibration_params/calibration_params_right.json"
    params_stereo_path = "calibration_params/stereo_calibration_params.json"

    # Validate existing calibration files
    valid_left, left_params = are_params_valid(params_left_path)
    valid_right, right_params = are_params_valid(params_right_path)
    valid_stereo, stereo_params = are_params_valid(params_stereo_path)

    # Perform calibration if parameters are invalid or missing
    if not (valid_left and valid_right and valid_stereo):
        stereo_calibration(
            chessBoardSize=(10, 7),
            squareRealDimensions=50.0,
            calibImgDirPath_left=left_camera_dir,
            calibImgDirPath_right=right_camera_dir,
            globImgExtension="png",
            saveCalibrationParams=True,
            calibrationParamsPath_left=params_left_path,
            calibrationParamsPath_right=params_right_path,
            saveStereoCalibrationParams=True,
            stereoCalibrationParamsPath=params_stereo_path,
        )

        # Revalidate parameters after calibration
        valid_left, left_params = are_params_valid(params_left_path)
        valid_right, right_params = are_params_valid(params_right_path)
        valid_stereo, stereo_params = are_params_valid(params_stereo_path)

    # Ensure parameters are valid
    if not (valid_left and valid_right and valid_stereo):
        raise RuntimeError("Calibration unsuccessful. Parameters remain
invalid.")
```

Do kalibracji użyte zostały zdjęcia z folderu Stereo 2. Parametry zapisane do JSON.

Zadanie 2

```
image_dimensions = grayImg_left.shape[::-1]
result, camMat1, distCoeff1, camMat2, distCoeff2, rotationMatrix,
translationVector, essentialMatrix, fundamentalMatrix = cv.stereoCalibrate(
    objPoints,
    imgPoints_left,
    imgPoints_right,
    cameraMatrix_left,
    distortionCoefficients_left,
    cameraMatrix_right,
    distortionCoefficients_right,
    image_dimensions,
    criteria=terminationCriteria,
    flags=stereoCalibrationFlags
)
baseline_distance = np.round(np.linalg.norm(translationVector) * 0.1, 2)
```

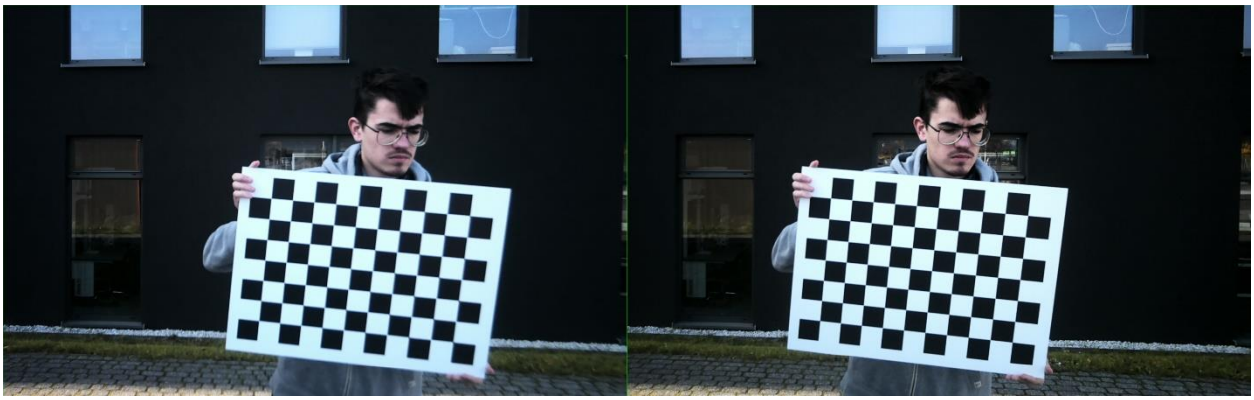
Kod źródłowy przedstawiający to w jaki sposób obliczana jest odległość pomiędzy kamerami w centymetrach. W tym wypadku wynosi ona 45.26cm. (cam2 i cam3)

Zadanie 3

```
if __name__ == "__main__":
    from zaowr_polsl_kisiel import are_params_valid, stereo_rectify,
stereo_calibration

    left_camera_path = r"Dataset/Chessboard/Stereo 2/cam2/"
    right_camera_path = r"Dataset/Chessboard/Stereo 2/cam3/"

    params_path_left = "calibration_params/calibration_params_left.json"
    params_path_right = "calibration_params/calibration_params_right.json"
    params_path_stereo = "calibration_params/stereo_calibration_params.json"

    # Validate existing calibration files
    valid_left, left_params = are_params_valid(params_path_left)
    valid_right, right_params = are_params_valid(params_path_right)
    valid_stereo, stereo_params = are_params_valid(params_path_stereo)

    # Perform calibration if parameters are invalid or missing
    if not (valid_left and valid_right and valid_stereo):
        stereo_calibration(
            chessBoardSize=(10, 7),
            squareRealDimensions=50.0,
            calibImgDirPath_left=left_camera_path,
            calibImgDirPath_right=right_camera_path,
            globImgExtension="png",
            saveCalibrationParams=True,
            calibrationParamsPath_left=params_path_left,
            calibrationParamsPath_right=params_path_right,
            saveStereoCalibrationParams=True,
```

```
            stereoCalibrationParamsPath=params_path_stereo,
        )

        # Revalidate parameters after calibration
        valid_left, left_params = are_params_valid(params_path_left)
        valid_right, right_params = are_params_valid(params_path_right)
        valid_stereo, stereo_params = are_params_valid(params_path_stereo)

    # Ensure parameters are valid
    if not (valid_left and valid_right and valid_stereo):
        raise RuntimeError("Calibration unsuccessful. Parameters remain
invalid.")

    rectified_output_dir = "./tests/rectified_images"

    stereo_rectify(
        calibImgDirPath_left=left_camera_path,
        calibImgDirPath_right=right_camera_path,
        imgPoints_left=left_params.get("imgPoints"),
        imgPoints_right=right_params.get("imgPoints"),
        loadStereoCalibrationParams=True,
        stereoCalibrationParamsPath=params_path_stereo,
        saveRectifiedImages=True,
        rectifiedImagesDirPath=rectified_output_dir,
        whichImage=5,
        drawEpipolarLinesParams=(0, 0, 0),
    )
```

Kod użyty do stereo rektyfikacji pary zdjęć.



Zadanie 4

Porównanie czasów obliczeń dla różnych metod.

Interpolation type INTER_NEAREST:

left_image: 0.0020426999999472173

right_image: 0.0015866000003370573

total: 0.0036293000002842746

Interpolation type INTER_LINEAR:
left_image: 0.003081900000324822
right_image: 0.002516499999728694
total: 0.005598400000053516

Interpolation type INTER_CUBIC:
left_image: 0.009511300000667688
right_image: 0.008982099999229831
total: 0.018493399999989752

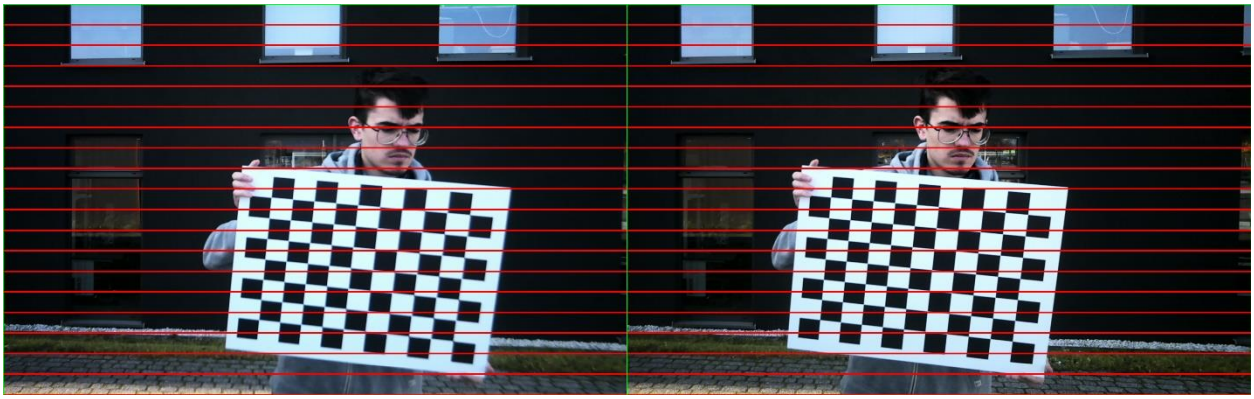
Interpolation type INTER_AREA:
left_image: 0.0027082999995400314
right_image: 0.0031072000001586275
total: 0.005815499999698659

Interpolation type INTER_LANCZOS4:
left_image: 0.030135200000586337
right_image: 0.02545029999964754
total: 0.05558550000023388

Metody INTER_LINEAR i INTER_AREA dają podobne, przeciętne rezultaty, podczas gdy INTER_CUBIC i INTER_LANCZOS4 oferują najlepszą jakość dzięki większej szczegółowości i naturalnym odcieniom, natomiast INTER_NEAREST wypada najgorzej z powodu widocznych "blokowych" artefaktów.

Zadanie 5 i 6

Zrektyfikowane zdjęcie z narysowanymi liniami epipolarnymi wyeksportowane do formatu PNG.



Kod źródłowy wykorzystany do przeprowadzenia laboratorium znajduje się w repozytorium GitHub.