# Random Interpolation Resize: A free image data augmentation method for object detection in industry

School of Instrument Science and Opto-electronic Engineering, Hefei University of Technology, Hefei 230009, China

Dahang Wan, Rongsheng Lu *, Ting Xu, Siyuan Shen, Xianli Lang, Zhijie Ren

论文链接：https://www.sciencedirect.com/science/article/pii/S0957417423008576

开源地址： https://github.com/wandahangFY/RIR .

# 1.论文动机：从插值方式的角度进行数据增强（详情请看原文）

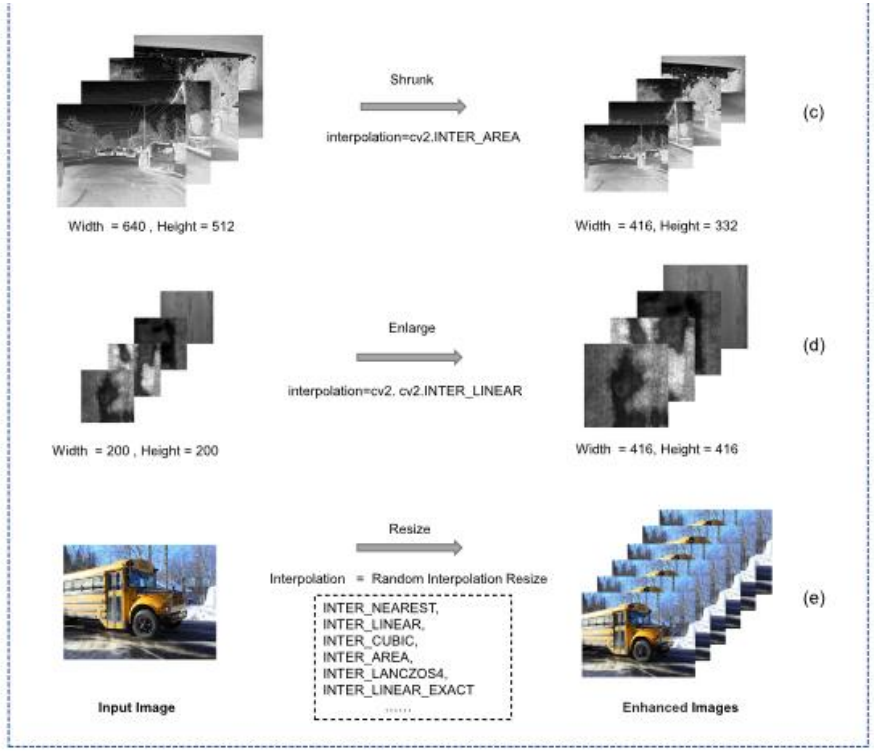



**Fig. 2.** Comparison of different methods of resize.

不使用RIR 方法：多个epoch迭代，每张图片只有一种插值方式

使用RIR 方法：多次迭代，每张图片可以有不同的插值方式

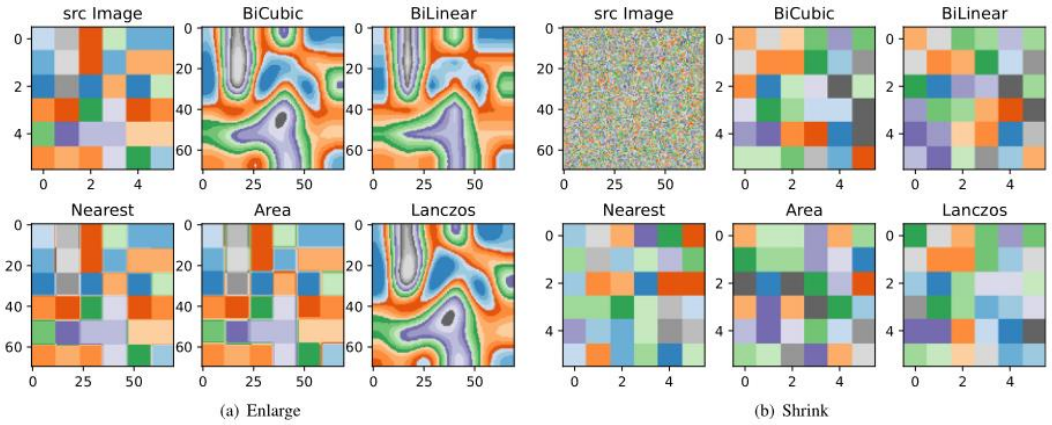



**Fig. 3.** Comparison of the results of various interpolation methods.

图3采用不同的插值方式对原图（src Image ）进行放大或缩小
从图中可以看出，不同的插值方式之间是有差异的

# 2.原理：在训练阶段随机使用插值方式，在测试阶段采用默认的插值方式

## 训练阶段

使用RIR 方法

```
interp = random_interpolation_resize(
        cv_resize_flags_with_weights=self.cv_resize_flags_with_weights)
```

## 验证阶段

不使用RIR 方法

（采用常规的插值方式）

（YOLOv8，11月之前有两种插值方式，

11月以后全部变成了双线性插值）

```
interp = cv2.INTER_LINEAR if (self.augment or r > 1) else cv2.INTER_AREA
```

使用RIR 方法

```
# ----------------------------------------------------rir start----------------------------------------
if self.use_rir:
    if self.val_flag:
        interp = cv2.INTER_LINEAR if (self.augment or r > 1) else cv2.INTER_AREA
        # print("use_rir={},val_flag={}".format(self.use_rir,self.val_flag))
    else:
        interp = random_interpolation_resize(
            cv_resize_flags_with_weights=self.cv_resize_flags_with_weights)
        # print("use_rir={},val_flag={}".format(self.use_rir, self.val_flag))
else:
    interp = cv2.INTER_LINEAR if (self.augment or r > 1) else cv2.INTER_AREA
im = cv2.resize(im,
                (min(math.ceil(w0 * r), self.imgsz), min(math.ceil(h0 * r), self.imgsz)),
                interpolation=interp)
# ----------------------------------------------------rir  end----------------------------------------
```

# 3.添加教程

3.1 YOLOv8 添加步骤(已完成)

3.2 YOLOv5 添加步骤(TODO)

3.3 YOLOv7 添加步骤(TODO)

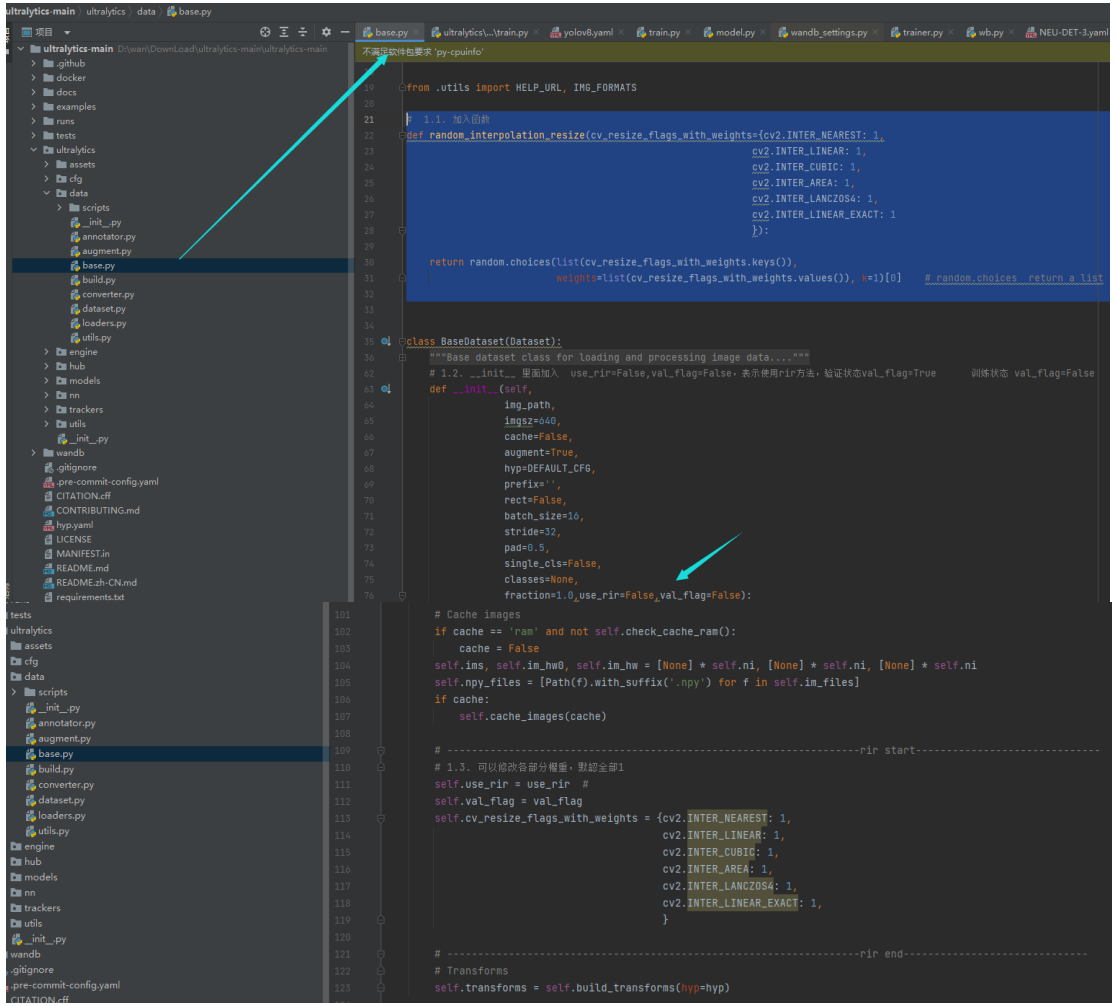
3.4 YOLOv5超参数进化 添加步骤(TODO)

# 3.1 YOLOv8 添加步骤

## 1. base.py 内部更改

ultralytics/data/base.py 11月以后版本（最新版）

ultralytics/yolo/data/base.py 11月以前的版本




```
# 1.1. 加入函数
def random_interpolation_resize(cv_resize_flags_with_weights={cv2.INTER_NEAREST: 1,
                                                              cv2.INTER_LINEAR: 1,
                                                              cv2.INTER_CUBIC: 1,
                                                              cv2.INTER_AREA: 1,
                                                              cv2.INTER_LANCZOS4: 1,
                                                              cv2.INTER_LINEAR_EXACT: 1
                                                              }):

    return random.choices(list(cv_resize_flags_with_weights.keys()),
                          weights=list(cv_resize_flags_with_weights.values()), k=1)[0]    # random.choices  return a list
```

```
# 1.2. __init__ 里面加入  use_rir=False,val_flag=False    表示使用rir方法，验证状态val_flag=True      训练状态 val_flag=False
```

```
# ----------rir start----------
# 1.3. 引入相关参数，可以修改各部分權重，默認全部1
self.use_rir = use_rir  #
self.val_flag = val_flag
self.cv_resize_flags_with_weights = {cv2.INTER_NEAREST: 1,
                                     cv2.INTER_LINEAR: 1,
                                     cv2.INTER_CUBIC: 1,
                                     cv2.INTER_AREA: 1,
                                     cv2.INTER_LANCZOS4: 1,
                                     cv2.INTER_LINEAR_EXACT: 1,
                                     }

# ----------rir end----------
```

# 3.1 YOLOv8 添加步骤

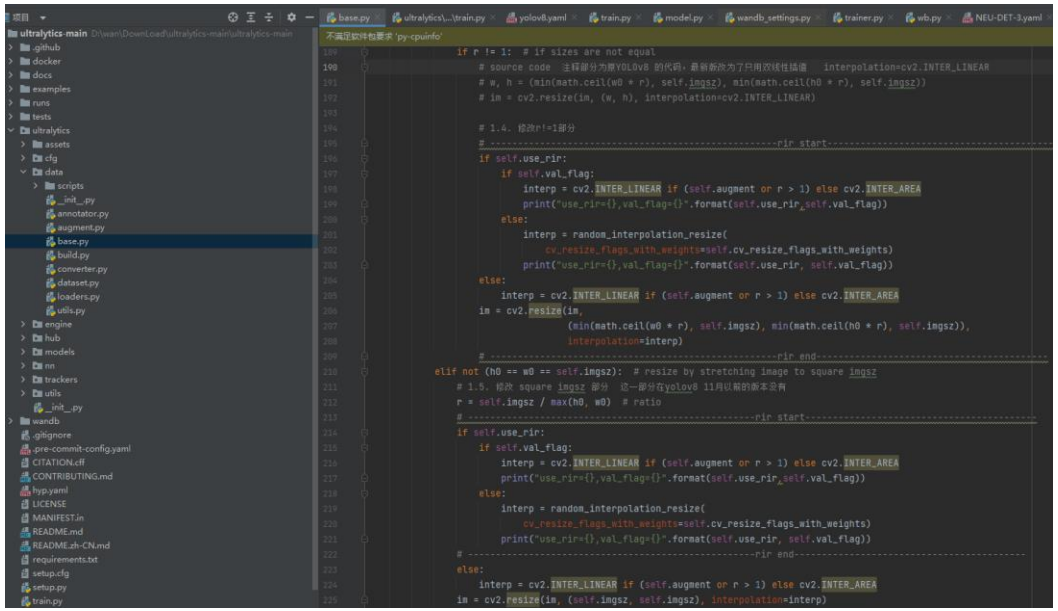
## 1. base.py 内部更改(11月以后)

1.4. 修改r!=1部分

1.5. 修改 square imgsz 部分　这一部分在YOLOv8 11月以前的版本没有

```
class BaseDataset(Dataset):
```

```
def load_image(self, i, rect_mode=True):
```



```
if rect_mode:  # resize long side to imgsz while maintaining aspect ratio
    r = self.imgsz / max(h0, w0)  # ratio
    if r != 1:  # if sizes are not equal
        # source code  注释部分为原YOLOv8 的代码，最新版改为了只用双线性插值
interpolation=cv2.INTER_LINEAR
        # w, h = (min(math.ceil(w0 * r), self.imgsz), min(math.ceil(h0 * r), self.imgsz))
        # im = cv2.resize(im, (w, h), interpolation=cv2.INTER_LINEAR)

        # 1.4. 修改r!=1部分
            # ----------------------------------------------rir start----------------------------------------
        if self.use_rir:
            if self.val_flag:
                interp = cv2.INTER_LINEAR if (self.augment or r > 1) else cv2.INTER_AREA
                print("use_rir={},val_flag={}".format(self.use_rir,self.val_flag))
            else:
                interp = random_interpolation_resize(
                    cv_resize_flags_with_weights=self.cv_resize_flags_with_weights)
                print("use_rir={},val_flag={}".format(self.use_rir, self.val_flag))
        else:
            interp = cv2.INTER_LINEAR if (self.augment or r > 1) else cv2.INTER_AREA
        im = cv2.resize(im,
                        (min(math.ceil(w0 * r), self.imgsz), min(math.ceil(h0 * r), self.imgsz)),
                        interpolation=interp)
        # ----------------------------------------------rir end----------------------------------------
elif not (h0 == w0 == self.imgsz):  # resize by stretching image to square imgsz
    # 1.5. 修改 square imgsz 部分　这一部分在yolov8 11月以前的版本没有
        r = self.imgsz / max(h0, w0)  # ratio
    # ----------------------------------------------rir start----------------------------------------
    if self.use_rir:
        if self.val_flag:
            interp = cv2.INTER_LINEAR if (self.augment or r > 1) else cv2.INTER_AREA
            print("use_rir={},val_flag={}".format(self.use_rir,self.val_flag))
        else:
            interp = random_interpolation_resize(
                cv_resize_flags_with_weights=self.cv_resize_flags_with_weights)
            print("use_rir={},val_flag={}".format(self.use_rir, self.val_flag))
    # ----------------------------------------------rir end----------------------------------------
    else:
        interp = cv2.INTER_LINEAR if (self.augment or r > 1) else cv2.INTER_AREA
    im = cv2.resize(im, (self.imgsz, self.imgsz), interpolation=interp)
```

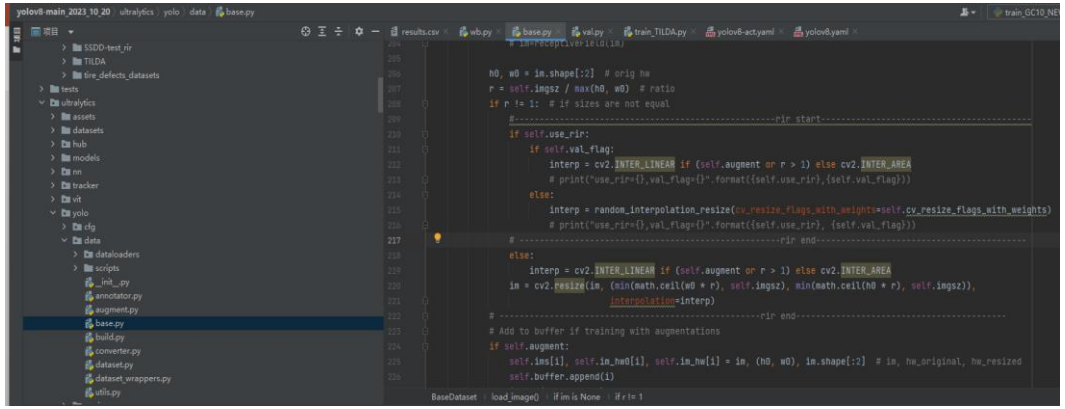
# 3.1 YOLOv8 添加步骤

## 1. base.py 内部更改(11月以前的版本)

1.4. 修改r!=1部分

```
class BaseDataset(Dataset):
```

```
def load_image(self, i, rect_mode=True):
```



```
if r != 1:  # if sizes are not equal
    #-----------------------------------------------rir start----------------------------------------
    if self.use_rir:
        if self.val_flag:
            interp = cv2.INTER_LINEAR if (self.augment or r > 1) else cv2.INTER_AREA
            # print("use_rir={},val_flag={}".format({self.use_rir},{self.val_flag}))
        else:
            interp =
random_interpolation_resize(cv_resize_flags_with_weights=self.cv_resize_flags_with_weights
)
            # print("use_rir={},val_flag={}".format({self.use_rir}, {self.val_flag}))
    # ----------------------------------------------rir end----------------------------------------
    else:
        interp = cv2.INTER_LINEAR if (self.augment or r > 1) else cv2.INTER_AREA
    im = cv2.resize(im, (min(math.ceil(w0 * r), self.imgsz), min(math.ceil(h0 * r), self.imgsz)),
                    interpolation=interp)
# ----------------------------------------------rir end----------------------------------------
```

# 3.1 YOLOv8 添加步骤

## 1. base.py 内部更改(11月以后的版本)

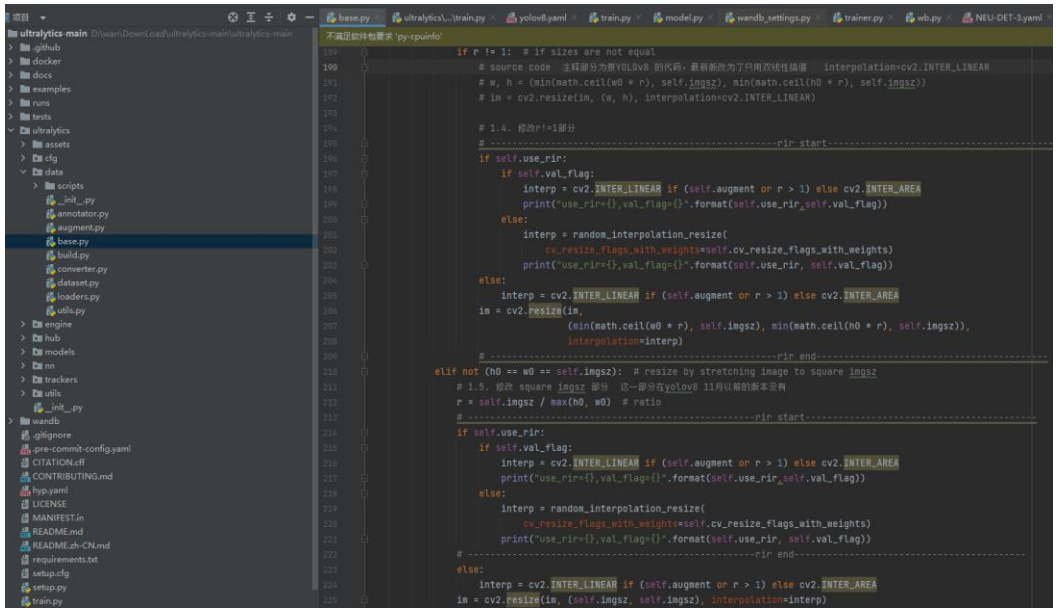
```
if rect_mode:
```

```
class BaseDataset(Dataset):
```

```
def load_image(self, i, rect_mode=True):
```

1.4. 修改r!=1部分

1.5. 修改 square imgsz 部分　这一部分在YOLOv8 11月以前的版本没有



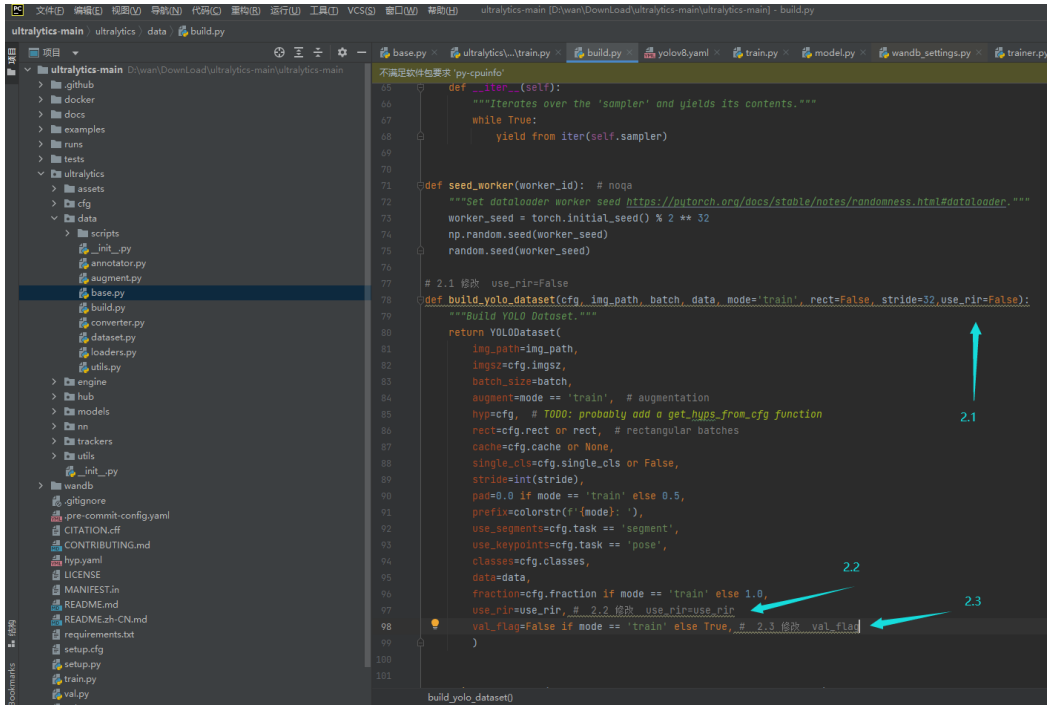
```
if rect_mode:  # resize long side to imgsz while maintaining aspect ratio
    r = self.imgsz / max(h0, w0)  # ratio
    if r != 1:  # if sizes are not equal
        # source code  注释部分为原YOLOv8 的代码，最新版改为了只用双线性插值
interpolation=cv2.INTER_LINEAR
        # w, h = (min(math.ceil(w0 * r), self.imgsz), min(math.ceil(h0 * r), self.imgsz))
        # im = cv2.resize(im, (w, h), interpolation=cv2.INTER_LINEAR)

        # 1.4. 修改r!=1部分
            # ----------------------------------------------rir start----------------------------------------
        if self.use_rir:
            if self.val_flag:
                interp = cv2.INTER_LINEAR if (self.augment or r > 1) else cv2.INTER_AREA
                print("use_rir={},val_flag={}".format(self.use_rir,self.val_flag))
            else:
                interp = random_interpolation_resize(
                    cv_resize_flags_with_weights=self.cv_resize_flags_with_weights)
                print("use_rir={},val_flag={}".format(self.use_rir, self.val_flag))
        else:
            interp = cv2.INTER_LINEAR if (self.augment or r > 1) else cv2.INTER_AREA
        im = cv2.resize(im,
                        (min(math.ceil(w0 * r), self.imgsz), min(math.ceil(h0 * r), self.imgsz)),
                        interpolation=interp)
        # ----------------------------------------------rir end----------------------------------------
elif not (h0 == w0 == self.imgsz):  # resize by stretching image to square imgsz
    # 1.5. 修改 square imgsz 部分　这一部分在yolov8 11月以前的版本没有
        r = self.imgsz / max(h0, w0)  # ratio
    # ----------------------------------------------rir start----------------------------------------
    if self.use_rir:
        if self.val_flag:
            interp = cv2.INTER_LINEAR if (self.augment or r > 1) else cv2.INTER_AREA
            print("use_rir={},val_flag={}".format(self.use_rir,self.val_flag))
        else:
            interp = random_interpolation_resize(
                cv_resize_flags_with_weights=self.cv_resize_flags_with_weights)
            print("use_rir={},val_flag={}".format(self.use_rir, self.val_flag))
    # ----------------------------------------------rir end----------------------------------------
    else:
        interp = cv2.INTER_LINEAR if (self.augment or r > 1) else cv2.INTER_AREA
    im = cv2.resize(im, (self.imgsz, self.imgsz), interpolation=interp)
```

# 3.1 YOLOv8 添加步骤

ultralytics/data/build.py

ultralytics/yolo/data/build.py

## 2. build.py build_yolo_dataset




```python
# 2.1 修改  use_rir=False
def build_yolo_dataset(cfg, img_path, batch, data, mode='train', rect=False, stride=32,use_rir=False):
    """Build YOLO Dataset."""
    return YOLODataset(
        img_path=img_path,
        imgsz=cfg.imgsz,
        batch_size=batch,
        augment=mode == 'train',  # augmentation
        hyp=cfg,  # TODO: probably add a get_hyps_from_cfg function
        rect=cfg.rect or rect,  # rectangular batches
        cache=cfg.cache or None,
        single_cls=cfg.single_cls or False,
        stride=int(stride),
        pad=0.0 if mode == 'train' else 0.5,
        prefix=colorstr(f'{mode}: '),
        use_segments=cfg.task == 'segment',
        use_keypoints=cfg.task == 'pose',
        classes=cfg.classes,
        data=data,
        fraction=cfg.fraction if mode == 'train' else 1.0,
        use_rir=use_rir, #  2.2 修改  use_rir=use_rir
        val_flag=False if mode == 'train' else True, #  2.3 修改  val_flag
        )
```

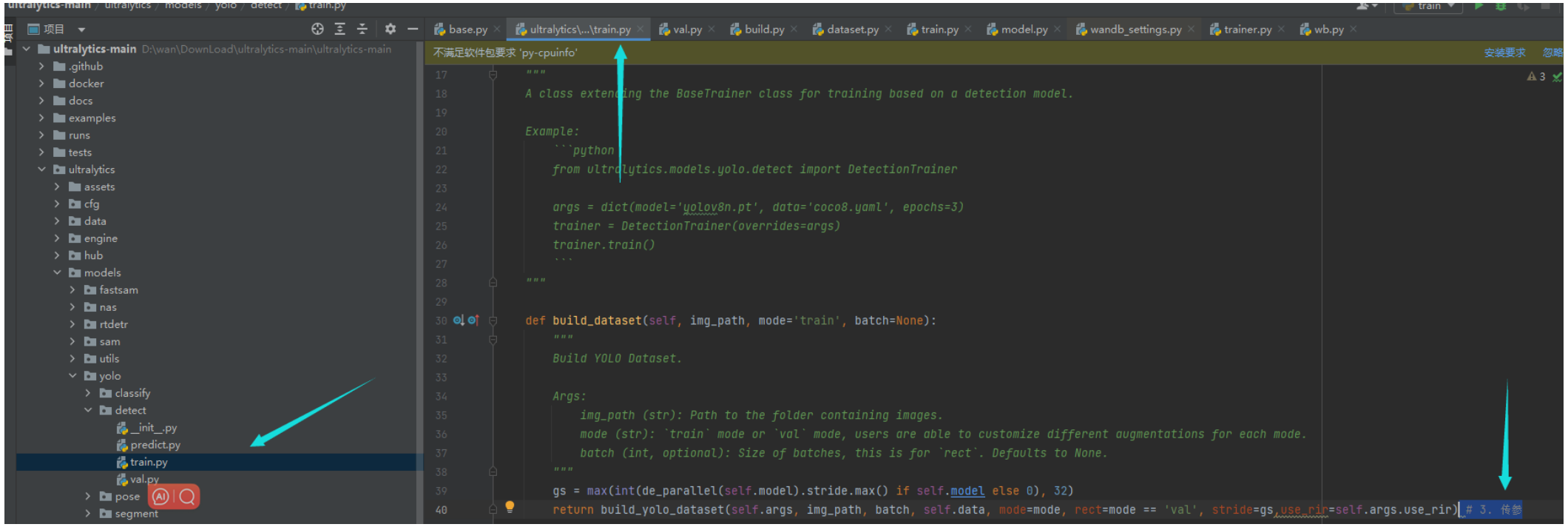
# 3.1 YOLOv8 添加步骤

3. ultralytics/models/yolo/detect/train.py

```
class DetectionTrainer(BaseTrainer):
```

传参

```
def build_dataset(self, img_path, mode='train', batch=None):
    """
    Build YOLO Dataset.

    Args:
        img_path (str): Path to the folder containing images.
        mode (str): `train` mode or `val` mode, users are able to customize different augmentations for each mode.
        batch (int, optional): Size of batches, this is for `rect`. Defaults to None.
    """
    gs = max(int(de_parallel(self.model).stride.max() if self.model else 0), 32)
    return build_yolo_dataset(self.args, img_path, batch, self.data, mode=mode, rect=mode == 'val',
stride=gs,use_rir=self.args.use_rir) # 3. 传参
```



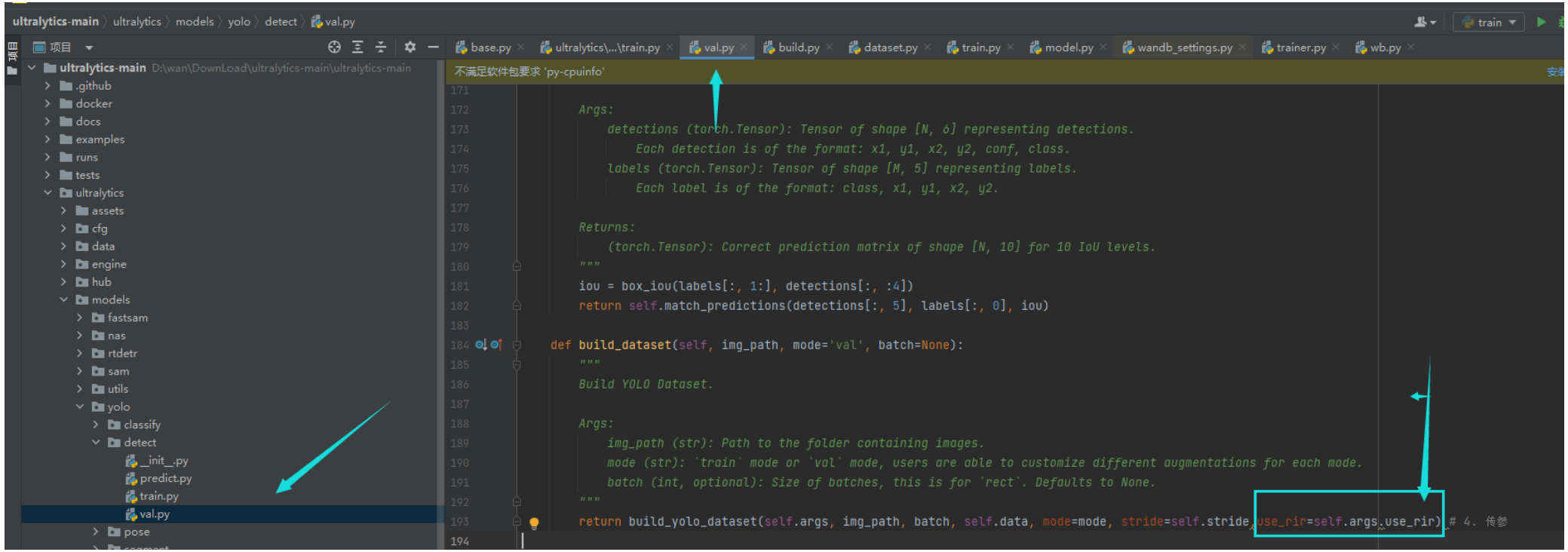
# 3.1 YOLOv8 添加步骤

4. ultralytics/models/yolo/detect/val.py

传参

```
class DetectionValidator(BaseValidator):
```

```
def build_dataset(self, img_path, mode='val', batch=None):
    """
    Build YOLO Dataset.

    Args:
        img_path (str): Path to the folder containing images.
        mode (str): `train` mode or `val` mode, users are able to customize different augmentations for each mode.
        batch (int, optional): Size of batches, this is for `rect`. Defaults to None.
    """
    return build_yolo_dataset(self.args, img_path, batch, self.data, mode=mode,
stride=self.stride,use_rir=self.args.use_rir) # 4. 传参
```

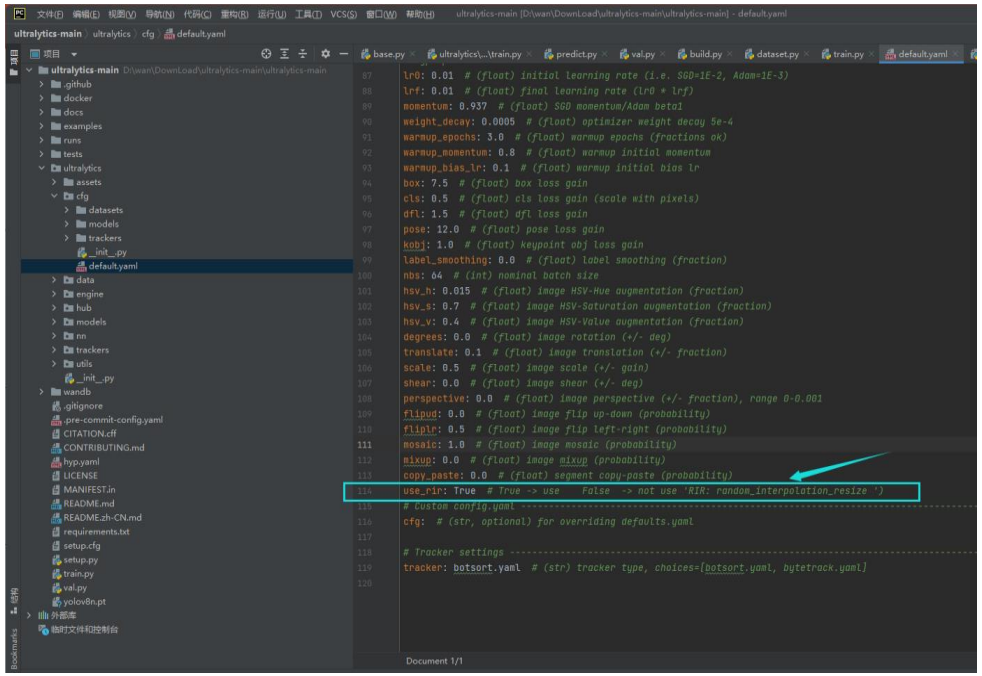


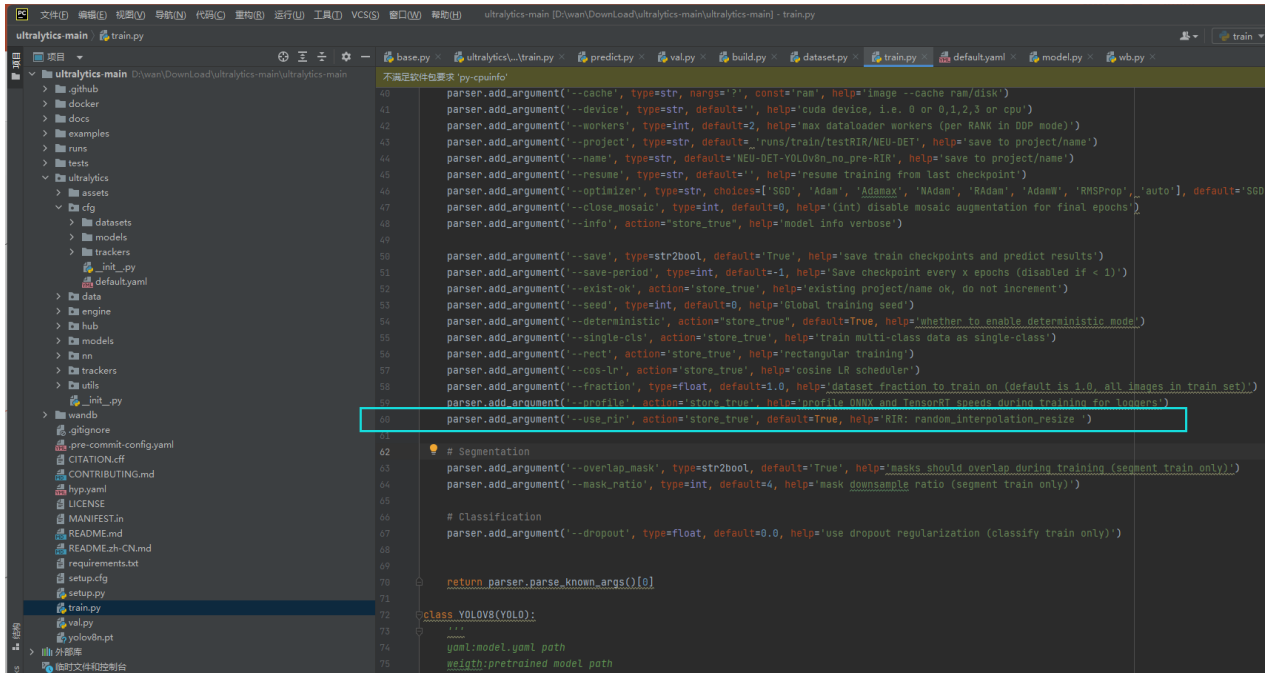
# 3.1 YOLOv8 添加步骤

5. ultralytics/cfg/default.yaml 添加
train.py 添加（如果有的话）

```
use_rir: True  # True -> use    False  -> not use 'RIR: random_interpolation_resize ')
```

```
parser.add_argument('--use_rir', action='store_true', default=True, help='RIR: random_interpolation_resize ')
```

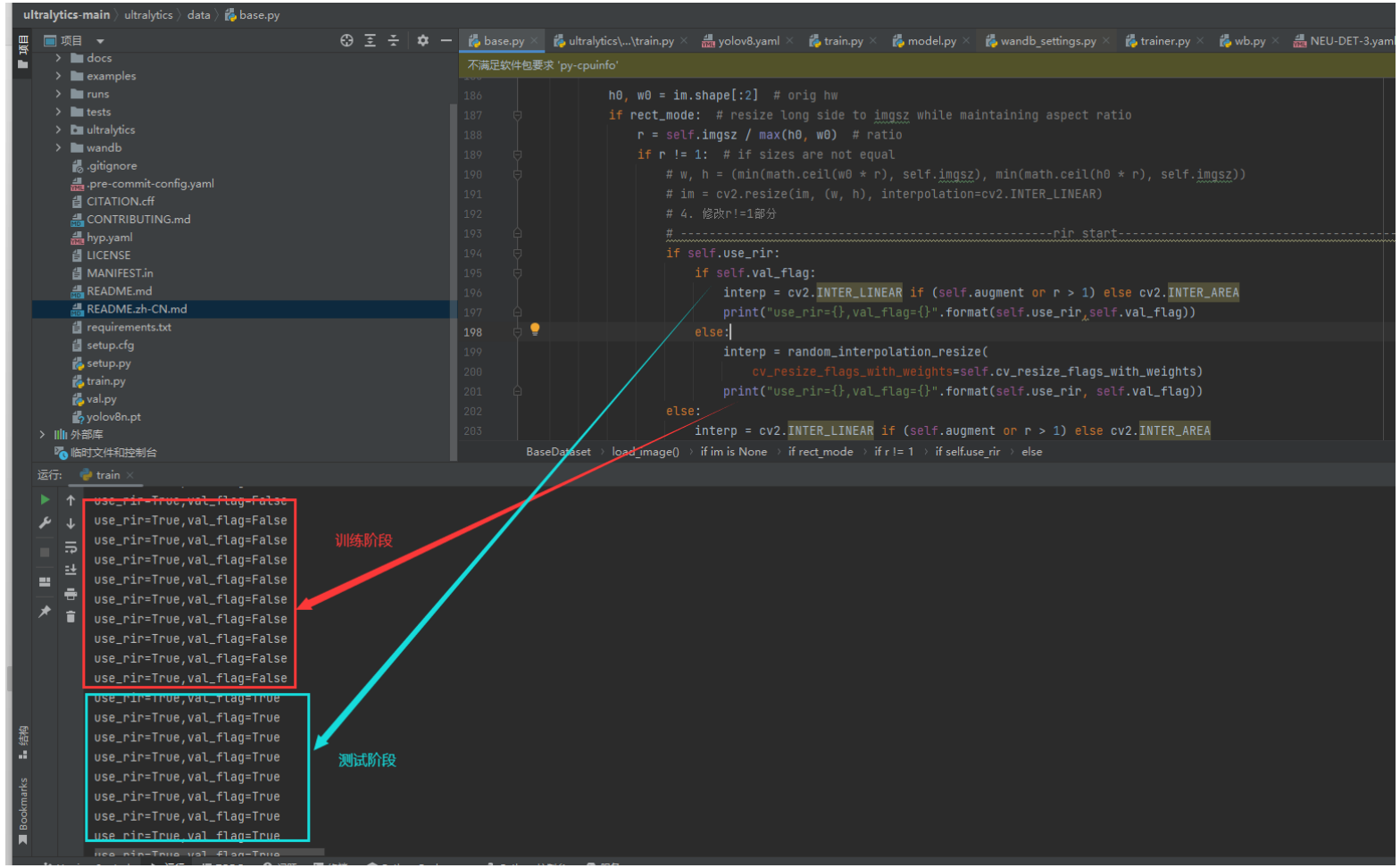


# 3.1 YOLOv8 添加步骤

6.验证

（1）按照正常YOLOv8的训练步骤进行模型训练
（2）如果正确显示图中的内容，则表示添加成功，注释掉print，按原本的步骤运行即可



4.延伸创新点：（未做试验，欢迎继续探讨）

（1）分patch，每个patch采用不同的插值方式
（2）在训练和测试阶段均采用随机的插值方式
（3）在训练阶段最后n(n=30)个epoch
（4）其他可以类比的方法也可以采用 random，试试效果

加工作量：

（1）搭配超参数进化，提升工作量（已在YOLOv5-6.1版本添加）
（2）搭配其他数据增强方法，组合成特定数据集（比如NEU-DET、GC10等）或者特定领域（工业检测、遥感领域等）的方法