In [4]:
```
import os
import gdown
import glob
import numpy as np
import matplotlib.pyplot as plt
from tqdm import tqdm

import torch
import torch.nn as nn
from torch.utils.data import Dataset, DataLoader
import torch.optim as optim
import torchvision.transforms as transforms

from skimage.metrics import structural_similarity as ssim_metric, peak_signa
```

In [ ]:
```
import zipfile
file_id = "1uJmDZw649XS-r-dYs9WD-OPwF_TIroVw"
output = "dataset.zip"
gdown.download(f"https://drive.google.com/uc?id={file_id}", output, quiet =

with zipfile.ZipFile("dataset.zip", "r") as zip_ref:
  zip_ref.extractall("/content/dataset")
```

```
Downloading...
From (original): https://drive.google.com/uc?id=1uJmDZw649XS-r-dYs9WD-OPwF_T
IroVw
From (redirected): https://drive.google.com/uc?id=1uJmDZw649XS-r-dYs9WD-OPwF
_TIroVw&confirm=t&uuid=22729b50-4fdf-4c1c-b3c3-082e85210db3
To: /content/dataset.zip
100%|██████████| 533M/533M [00:06<00:00, 81.6MB/s]
```

In [6]:
```
class LensingDataset(Dataset):
  def __init__(self, root_dir, transform = None):
    super(LensingDataset, self).__init__()
    self.root_dir = root_dir
    self.hr_dir = os.path.join(root_dir, 'HR')
    self.lr_dir = os.path.join(root_dir, 'LR')
    self.lr_files = sorted(glob.glob(os.path.join(self.lr_dir, '*.npy')))
    self.hr_files = sorted(glob.glob(os.path.join(self.hr_dir, '*.npy')))
    self.transform = transform

  def __len__(self):
    return len(self.lr_files)

  def __getitem__(self, idx):
    lr_image = np.load(self.lr_files[idx])
    hr_image = np.load(self.hr_files[idx])

    lr_image = torch.from_numpy(lr_image).float()
    hr_image = torch.from_numpy(hr_image).float()

    if self.transform:
      lr_image = self.transform(lr_image)
      hr_image = self.transform(hr_image)
```

```
    lr_image = lr_image.repeat(3, 1, 1)
    hr_image = hr_image.repeat(3, 1, 1)
    return lr_image, hr_image
```

In [10]:
```
class ResidualBlock(nn.Module):
    def __init__(self, n_feats, kernel_size=3, res_scale=0.1):
        super(ResidualBlock, self).__init__()
        self.res_scale = res_scale
        self.block = nn.Sequential(
            nn.Conv2d(n_feats, n_feats, kernel_size, padding=kernel_size//2)
            nn.ReLU(inplace=True),
            nn.Conv2d(n_feats, n_feats, kernel_size, padding=kernel_size//2)
        )

    def forward(self, x):
        res = self.block(x)
        return x + res * self.res_scale
```

In [11]:
```
class EDSR(nn.Module):
    def __init__(self, scale_factor=2, n_resblocks=16, n_feats=64, res_scale
        super(EDSR, self).__init__()
        self.head = nn.Conv2d(n_colors, n_feats, kernel_size=3, padding=1)

        self.body = nn.Sequential(
            *[ResidualBlock(n_feats, kernel_size=3, res_scale=res_scale) for
        )
        self.body_conv = nn.Conv2d(n_feats, n_feats, kernel_size=3, padding=

        self.tail = nn.Sequential(
            nn.Conv2d(n_feats, n_feats * (scale_factor ** 2), kernel_size=3,
            nn.PixelShuffle(scale_factor),
            nn.Conv2d(n_feats, n_colors, kernel_size=3, padding=1)
        )

    def forward(self, x):
        x = self.head(x)
        res = self.body(x)
        res = self.body_conv(res)
        x = x + res
        x = self.tail(x)
        return x
```

In [13]:
```
scale = 2
print("Initializing EDSR model...")
model = EDSR(scale_factor=scale, n_resblocks=8, n_feats=64, res_scale=0.1, r
model
```

```
Initializing EDSR model...
```

Out[13]:
```
EDSR(
  (head): Conv2d(3, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
  (body): Sequential(
    (0): ResidualBlock(
      (block): Sequential(
        (0): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1))
        (1): ReLU(inplace=True)
        (2): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1))
      )
    )
    (1): ResidualBlock(
      (block): Sequential(
        (0): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1))
        (1): ReLU(inplace=True)
        (2): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1))
      )
    )
    (2): ResidualBlock(
      (block): Sequential(
        (0): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1))
        (1): ReLU(inplace=True)
        (2): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1))
      )
    )
    (3): ResidualBlock(
      (block): Sequential(
        (0): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1))
        (1): ReLU(inplace=True)
        (2): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1))
      )
    )
    (4): ResidualBlock(
      (block): Sequential(
        (0): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1))
        (1): ReLU(inplace=True)
        (2): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1))
      )
    )
    (5): ResidualBlock(
      (block): Sequential(
        (0): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1))
        (1): ReLU(inplace=True)
        (2): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1))
      )
```

```
    )
    (6): ResidualBlock(
      (block): Sequential(
        (0): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1))
        (1): ReLU(inplace=True)
        (2): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1))
      )
    )
    (7): ResidualBlock(
      (block): Sequential(
        (0): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1))
        (1): ReLU(inplace=True)
        (2): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1))
      )
    )
  )
  (body_conv): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=
(1, 1))
  (tail): Sequential(
    (0): Conv2d(64, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (1): PixelShuffle(upscale_factor=2)
    (2): Conv2d(64, 3, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
  )
)
```

In [14]:
```
device = 'cuda' if torch.cuda.is_available() else 'cpu'
model = model.to(device)
```

In [15]:
```
criterion = nn.MSELoss()
optimizer = optim.Adam(model.parameters(), lr=1e-4)
```

In [16]:
```
root_dir = "/content/dataset/Dataset"
train_dataset = LensingDataset(root_dir)
```

In [17]:
```
train_loader = DataLoader(train_dataset, batch_size=8, shuffle=True, num_wor
```

In [18]:
```
num_epochs = 10
print("Starting training on {} for {} epochs...".format(device, num_epochs))
for epoch in range(num_epochs):
    model.train()
    running_loss = 0.0
    for lr_imgs, hr_imgs in tqdm(train_loader, desc=f"Epoch {epoch+1}/{num_e
        lr_imgs = lr_imgs.to(device)
        hr_imgs = hr_imgs.to(device)

        optimizer.zero_grad()
        outputs = model(lr_imgs)
        loss = criterion(outputs, hr_imgs)
        loss.backward()
        optimizer.step()
```

```
        running_loss += loss.item() * lr_imgs.size(0)

    epoch_loss = running_loss / len(train_dataset)
    print("Epoch [{}/{}], Loss: {:.6f}".format(epoch+1, num_epochs, epoch_lo
```

```
Starting training on cuda for 10 epochs...
Epoch 1/10: 100%|██████████| 1250/1250 [01:18<00:00, 15.91it/s]
Epoch [1/10], Loss: 0.000168
Epoch 2/10: 100%|██████████| 1250/1250 [01:18<00:00, 15.86it/s]
Epoch [2/10], Loss: 0.000060
Epoch 3/10: 100%|██████████| 1250/1250 [01:20<00:00, 15.48it/s]
Epoch [3/10], Loss: 0.000060
Epoch 4/10: 100%|██████████| 1250/1250 [01:20<00:00, 15.49it/s]
Epoch [4/10], Loss: 0.000059
Epoch 5/10: 100%|██████████| 1250/1250 [01:20<00:00, 15.47it/s]
Epoch [5/10], Loss: 0.000059
Epoch 6/10: 100%|██████████| 1250/1250 [01:21<00:00, 15.40it/s]
Epoch [6/10], Loss: 0.000059
Epoch 7/10: 100%|██████████| 1250/1250 [01:20<00:00, 15.45it/s]
Epoch [7/10], Loss: 0.000059
Epoch 8/10: 100%|██████████| 1250/1250 [01:21<00:00, 15.42it/s]
Epoch [8/10], Loss: 0.000059
Epoch 9/10: 100%|██████████| 1250/1250 [01:21<00:00, 15.41it/s]
Epoch [9/10], Loss: 0.000059
Epoch 10/10: 100%|██████████| 1250/1250 [01:21<00:00, 15.43it/s]
Epoch [10/10], Loss: 0.000059
```

In [19]:

```
def evaluate(model, dataloader, device):
    model.eval()
    mse_total, ssim_total, psnr_total = 0.0, 0.0, 0.0
    count = 0
    with torch.no_grad():
        for lr_imgs, hr_imgs in tqdm(dataloader, desc="Evaluating"):
            lr_imgs = lr_imgs.to(device)
            hr_imgs = hr_imgs.to(device)

            outputs = model(lr_imgs)
            outputs_np = outputs.cpu().numpy()
            hr_imgs_np = hr_imgs.cpu().numpy()

            for i in range(outputs_np.shape[0]):
                # Convert to grayscale by taking the first channel.
                sr = outputs_np[i, 0, :, :]
                hr = hr_imgs_np[i, 0, :, :]
                mse_val = np.mean((sr - hr) ** 2)
                ssim_val = ssim_metric(sr, hr, data_range=hr.max()-hr.min())
                psnr_val = psnr_metric(hr, sr, data_range=hr.max()-hr.min())

                mse_total += mse_val
                ssim_total += ssim_val
                psnr_total += psnr_val
                count += 1
```

```
    return mse_total/count, ssim_total/count, psnr_total/count
```

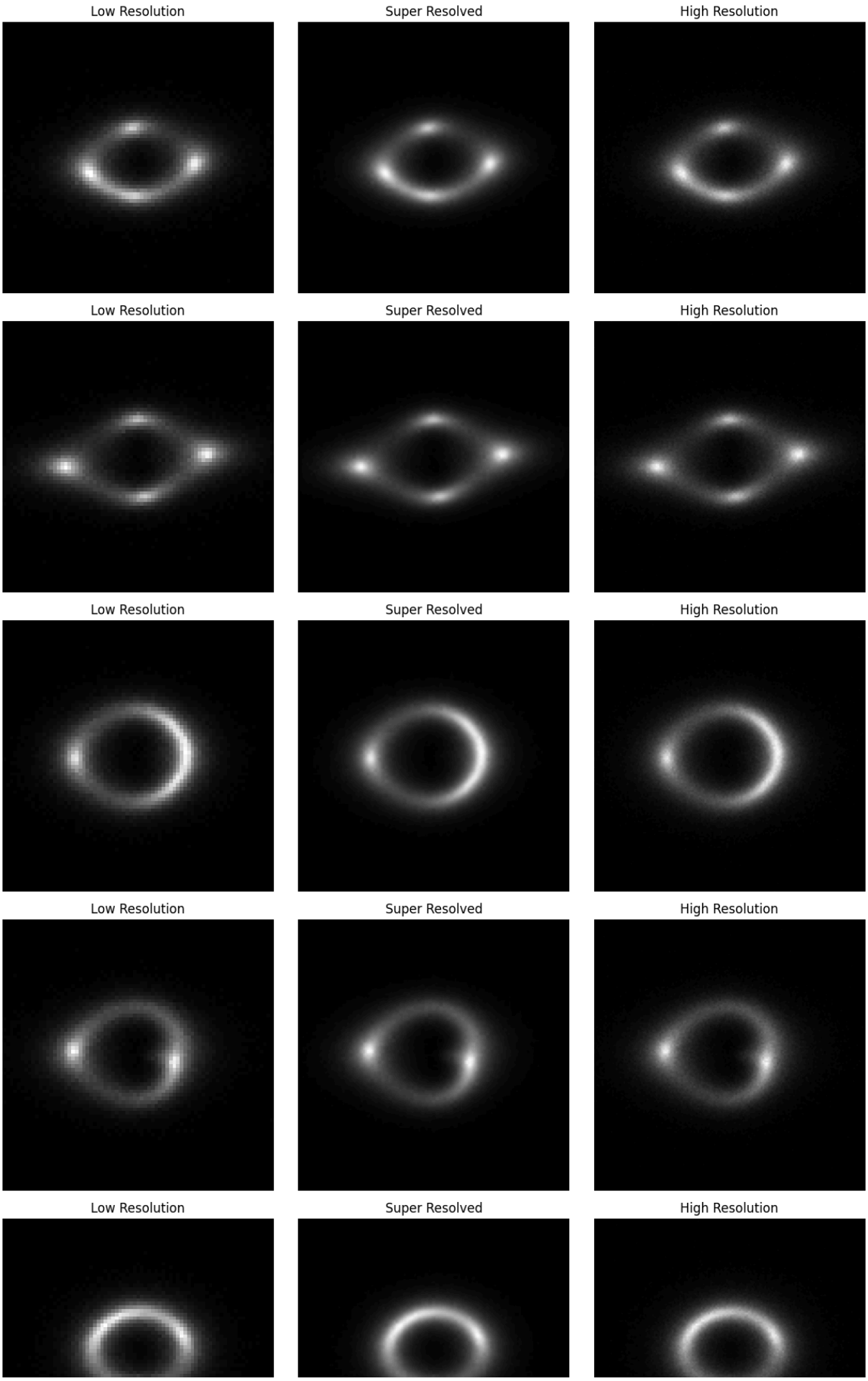
In [20]:
```
mse_val, ssim_val, psnr_val = evaluate(model, train_loader, device)
print("Evaluation Metrics:")
print("MSE: {:.6f}".format(mse_val))
print("SSIM: {:.6f}".format(ssim_val))
print("PSNR: {:.6f}".format(psnr_val))
```

```
Evaluating: 100%|██████████| 1250/1250 [00:48<00:00, 25.52it/s]
Evaluation Metrics:
MSE: 0.000059
SSIM: 0.977661
PSNR: 42.343273
```

In [21]:
```
def show_generated_images(model, dataloader, device, num_images=5):
    """
    Displays a few super-resolved images alongside the original LR and HR im
    """
    model.eval()
    lr_imgs, hr_imgs = next(iter(dataloader))
    lr_imgs = lr_imgs.to(device)
    hr_imgs = hr_imgs.to(device)

    with torch.no_grad():
        sr_imgs = model(lr_imgs)

    lr_imgs = lr_imgs.cpu().numpy()
    sr_imgs = sr_imgs.cpu().numpy()
    hr_imgs = hr_imgs.cpu().numpy()

    num_images = min(num_images, lr_imgs.shape[0])
    fig, axes = plt.subplots(num_images, 3, figsize=(12, 4 * num_images))

    if num_images == 1:
        axes = np.expand_dims(axes, axis=0)

    for i in range(num_images):
        lr_img = lr_imgs[i, 0, :, :]
        sr_img = sr_imgs[i, 0, :, :]
        hr_img = hr_imgs[i, 0, :, :]

        axes[i, 0].imshow(lr_img, cmap='gray')
        axes[i, 0].set_title("Low Resolution")
        axes[i, 0].axis('off')

        axes[i, 1].imshow(sr_img, cmap='gray')
        axes[i, 1].set_title("Super Resolved")
        axes[i, 1].axis('off')

        axes[i, 2].imshow(hr_img, cmap='gray')
        axes[i, 2].set_title("High Resolution")
        axes[i, 2].axis('off')
```

```
    plt.tight_layout()
    plt.show()
```

In [22]:
```
show_generated_images(model, train_loader, device, num_images=5)
```


Low Resolution
Super Resolved
High Resolution
Low Resolution
Super Resolved
High Resolution
Low Resolution
Super Resolved
High Resolution
Low Resolution
Super Resolved
High Resolution
Low Resolution
Super Resolved
High Resolution

In [23]:
```
torch.save(model.state_dict(), 'edsr_strong_lensing_finetuned.pth')
print("Model saved.")
```

```
Model saved.
```

In [24]:
```
file_id = "1plYfM-jFJT7TbTMVssuCCFvLzGdxMQ4h"
output = "datasetB.zip"
gdown.download(f"https://drive.google.com/uc?id={file_id}", output, quiet =

with zipfile.ZipFile("datasetB.zip", "r") as zip_ref:
  zip_ref.extractall("/content/datasetB")
```

```
Downloading...
From: https://drive.google.com/uc?id=1plYfM-jFJT7TbTMVssuCCFvLzGdxMQ4h
To: /content/datasetB.zip
100%|██████████| 21.6M/21.6M [00:00<00:00, 67.1MB/s]
```

In [25]:
```
path = "/content/datasetB/Dataset/HR/HR_1.npy"
image = np.load(path)
image.shape
```

Out[25]:
```
(1, 128, 128)
```

In [26]:
```
path = "/content/datasetB/Dataset/LR/LR_1.npy"
image = np.load(path)
image.shape
```

Out[26]:
```
(1, 64, 64)
```

In [37]:
```
class RealLensingDataset(Dataset):
  def __init__(self, root_dir, transform = None):
    super(RealLensingDataset, self).__init__()
    self.lr_dir = os.path.join(root_dir, 'LR')
    self.hr_dir = os.path.join(root_dir, 'HR')
    self.lr_files = sorted(glob.glob(os.path.join(self.lr_dir, '*.npy')))
    self.hr_files = sorted(glob.glob(os.path.join(self.hr_dir, '*.npy')))
    self.transform = transform

  def __len__(self):
    return len(self.lr_files)

  def __getitem__(self, idx):
    lr_img = np.load(self.lr_files[idx])
    hr_img = np.load(self.hr_files[idx])

    lr_img = torch.from_numpy(lr_img).float()
    hr_img = torch.from_numpy(hr_img).float()

    lr_img = lr_img.repeat(3, 1, 1)
    hr_img = hr_img.repeat(3, 1, 1)
```

```
    if self.transform:
      lr_img = self.transform(lr_img)
      hr_img = self.transform(hr_img)

    return lr_img, hr_img
```

In [38]:
```
scale = 2
print("Initializing EDSR model for fine-tuning...")
model = EDSR(scale_factor=scale, n_resblocks=8, n_feats=64, res_scale=0.1, r
```

```
Initializing EDSR model for fine-tuning...
```

In [39]:
```
pretrained_weights = 'edsr_strong_lensing_finetuned.pth'
model.load_state_dict(torch.load(pretrained_weights, map_location='cpu'))
print("Pre-trained weights loaded.")
```

```
Pre-trained weights loaded.
<ipython-input-39-95e6a2d481d0>:2: FutureWarning: You are using `torch.load`
with `weights_only=False` (the current default value), which uses the defaul
t pickle module implicitly. It is possible to construct malicious pickle dat
a which will execute arbitrary code during unpickling (See https://github.co
m/pytorch/pytorch/blob/main/SECURITY.md#untrusted-models for more details).
In a future release, the default value for `weights_only` will be flipped to
`True`. This limits the functions that could be executed during unpickling.
Arbitrary objects will no longer be allowed to be loaded via this mode unles
s they are explicitly allowlisted by the user via `torch.serialization.add_s
afe_globals`. We recommend you start setting `weights_only=True` for any use
case where you don't have full control of the loaded file. Please open an is
sue on GitHub for any issues related to this experimental feature.
  model.load_state_dict(torch.load(pretrained_weights, map_location='cpu'))
```

In [40]:
```
device = 'cuda' if torch.cuda.is_available() else 'cpu'
model = model.to(device)
```

In [41]:
```
criterion = nn.MSELoss()
optimizer = optim.Adam(model.parameters(), lr=1e-5)
```

In [45]:
```
import random
class RandomFlipRotate(object):
    """Apply random horizontal/vertical flips and random 90° rotations."""
    def __init__(self, p=0.5):
        self.p = p

    def __call__(self, image):
        if random.random() < self.p:
            image = torch.flip(image, dims=[2])  # horizontal flip
        if random.random() < self.p:
            image = torch.flip(image, dims=[1])  # vertical flip
        rotations = random.randint(0, 3)
        image = torch.rot90(image, k=rotations, dims=[1, 2])
        return image
```

In [43]:
```
root_dir = "/content/datasetB/Dataset"
data_transform = transforms.Compose([RandomFlipRotate(p=0.5)])
```

```
real_dataset = RealLensingDataset(root_dir, transform=data_transform)
real_loader = DataLoader(real_dataset, batch_size=4, shuffle=True, num_worke
```

In [46]:

```
num_finetune_epochs = 10
print("Starting fine-tuning on real data for {} epochs...".format(num_finetu
for epoch in range(num_finetune_epochs):
    model.train()
    running_loss = 0.0
    for lr_imgs, hr_imgs in tqdm(real_loader, desc=f"Fine-tune Epoch {epoch+
        lr_imgs = lr_imgs.to(device)
        hr_imgs = hr_imgs.to(device)

        optimizer.zero_grad()
        outputs = model(lr_imgs)
        loss = criterion(outputs, hr_imgs)
        loss.backward()
        optimizer.step()

        running_loss += loss.item() * lr_imgs.size(0)
    epoch_loss = running_loss / len(real_dataset)
    print("Epoch [{}/{}], Fine-tuning Loss: {:.6f}".format(epoch+1, num_fine
```

```
Starting fine-tuning on real data for 10 epochs...
Fine-tune Epoch 1/10:   0%|          | 0/75 [00:00<?, ?it/s]Exception ignore
d in: Exception ignored in: <function _MultiProcessingDataLoaderIter.__del__
at 0x7b8a4cd81b20><function _MultiProcessingDataLoaderIter.__del__ at 0x7b8a
4cd81b20>

Traceback (most recent call last):
Traceback (most recent call last):
  File "/usr/local/lib/python3.11/dist-packages/torch/utils/data/dataloader.
py", line 1604, in __del__
  File "/usr/local/lib/python3.11/dist-packages/torch/utils/data/dataloader.
py", line 1604, in __del__
        self._shutdown_workers()
self._shutdown_workers()  File "/usr/local/lib/python3.11/dist-packages/torc
h/utils/data/dataloader.py", line 1587, in _shutdown_workers
    if w.is_alive():

   File "/usr/local/lib/python3.11/dist-packages/torch/utils/data/dataloade
r.py", line 1587, in _shutdown_workers
    if w.is_alive():
     ^   ^^^^^^^^^^^^^^^^^^^^^^
  File "/usr/lib/python3.11/multiprocessing/process.py", line 160, in is_ali
ve
    assert self._parent_pid == os.getpid(), 'can only test a child process'

Fine-tune Epoch 1/10:   1%|          | 1/75 [00:00<00:21,  3.47it/s]    File
"/usr/lib/python3.11/multiprocessing/process.py", line 160, in is_alive
       assert self._parent_pid == os.getpid(), 'can only test a child proces
s'^
^^^  ^^ ^  ^ ^^ ^^^^^^^^  ^ ^ ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
^AssertionError^: ^can only test a child process^
Fine-tune Epoch 1/10:   4%|▍         | 3/75 [00:00<00:09,  7.27it/s]^^^^^
AssertionError: can only test a child process
Fine-tune Epoch 1/10: 100%|██████████| 75/75 [00:02<00:00, 33.72it/s]
```

```
Epoch [1/10], Fine-tuning Loss: 0.005273
Fine-tune Epoch 2/10: 100%|██████████| 75/75 [00:01<00:00, 41.05it/s]
Epoch [2/10], Fine-tuning Loss: 0.002429
Fine-tune Epoch 3/10: 100%|██████████| 75/75 [00:02<00:00, 35.98it/s]
Epoch [3/10], Fine-tuning Loss: 0.002132
Fine-tune Epoch 4/10: 100%|██████████| 75/75 [00:01<00:00, 39.50it/s]
Epoch [4/10], Fine-tuning Loss: 0.002031
Fine-tune Epoch 5/10: 100%|██████████| 75/75 [00:01<00:00, 41.31it/s]
Epoch [5/10], Fine-tuning Loss: 0.002033
Fine-tune Epoch 6/10: 100%|██████████| 75/75 [00:02<00:00, 36.07it/s]
Epoch [6/10], Fine-tuning Loss: 0.002003
Fine-tune Epoch 7/10: 100%|██████████| 75/75 [00:01<00:00, 38.54it/s]
Epoch [7/10], Fine-tuning Loss: 0.001978
Fine-tune Epoch 8/10: 100%|██████████| 75/75 [00:01<00:00, 40.85it/s]
Epoch [8/10], Fine-tuning Loss: 0.001985
Fine-tune Epoch 9/10: 100%|██████████| 75/75 [00:01<00:00, 41.25it/s]
Epoch [9/10], Fine-tuning Loss: 0.001930
Fine-tune Epoch 10/10: 100%|██████████| 75/75 [00:01<00:00, 40.60it/s]
Epoch [10/10], Fine-tuning Loss: 0.001934
```

In [47]:
```python
def evaluate(model, dataloader, device):
    model.eval()
    mse_total, ssim_total, psnr_total = 0.0, 0.0, 0.0
    count = 0
    with torch.no_grad():
        for lr_imgs, hr_imgs in tqdm(dataloader, desc="Evaluating"):
            lr_imgs = lr_imgs.to(device)
            hr_imgs = hr_imgs.to(device)
            outputs = model(lr_imgs)
            outputs_np = outputs.cpu().numpy()
            hr_imgs_np = hr_imgs.cpu().numpy()

            for i in range(outputs_np.shape[0]):
                # Convert to grayscale by taking the first channel.
                sr = outputs_np[i, 0, :, :]
                hr = hr_imgs_np[i, 0, :, :]
                mse_val = np.mean((sr - hr)**2)
                ssim_val = ssim_metric(sr, hr, data_range=hr.max()-hr.min())
                psnr_val = psnr_metric(hr, sr, data_range=hr.max()-hr.min())

                mse_total += mse_val
                ssim_total += ssim_val
                psnr_total += psnr_val
                count += 1
    return mse_total/count, ssim_total/count, psnr_total/count
```

In [48]:
```python
mse_val, ssim_val, psnr_val = evaluate(model, real_loader, device)
print("Evaluation Metrics on Real Data:")
print("MSE: {:.6f}".format(mse_val))
print("SSIM: {:.6f}".format(ssim_val))
print("PSNR: {:.6f}".format(psnr_val))
```

```
Evaluating: 100%|██████████| 75/75 [00:01<00:00, 55.58it/s]
```

```
Evaluation Metrics on Real Data:
MSE: 0.001903
SSIM: 0.757113
PSNR: 29.645286
```

In [49]:
```python
def show_generated_images(model, dataloader, device, num_images=5):
    """
    Displays LR input, SR output, and HR ground truth images side by side.
    """
    model.eval()
    lr_imgs, hr_imgs = next(iter(dataloader))
    lr_imgs = lr_imgs.to(device)
    hr_imgs = hr_imgs.to(device)

    with torch.no_grad():
        sr_imgs = model(lr_imgs)

    lr_imgs = lr_imgs.cpu().numpy()
    sr_imgs = sr_imgs.cpu().numpy()
    hr_imgs = hr_imgs.cpu().numpy()

    num_images = min(num_images, lr_imgs.shape[0])
    fig, axes = plt.subplots(num_images, 3, figsize=(12, 4 * num_images))
    if num_images == 1:
        axes = np.expand_dims(axes, axis=0)

    for i in range(num_images):
        lr_img = lr_imgs[i, 0, :, :]
        sr_img = sr_imgs[i, 0, :, :]
        hr_img = hr_imgs[i, 0, :, :]

        axes[i, 0].imshow(lr_img, cmap='gray')
        axes[i, 0].set_title("Low Resolution")
        axes[i, 0].axis('off')

        axes[i, 1].imshow(sr_img, cmap='gray')
        axes[i, 1].set_title("Super Resolved")
        axes[i, 1].axis('off')

        axes[i, 2].imshow(hr_img, cmap='gray')
        axes[i, 2].set_title("High Resolution")
        axes[i, 2].axis('off')

    plt.tight_layout()
    plt.show()
```

In [50]:
```python
show_generated_images(model, real_loader, device, num_images=5)
```