

SS-SIM Quick Operation Manual

1. Principle

Structured illumination microscopy (SIM) is a powerful super-resolution optical technique most suitable for live sample imaging. However, conventional SIM suffers from limited penetration depth (tens of micrometers) since its wide-field illumination is susceptible to sample scattering. To overcome this limitation, we developed a sparse scanning structured illumination microscopy (SS-SIM) as a super-resolution imaging technique for thick sample imaging. SS-SIM utilizes sparse fringe patterns generated by resonant scanning of a focused laser spot and synchronized intensity modulation. SS-SIM achieves a spatial resolution of 154 ± 12 nm, ~ 1.6 -fold enhancement over conventional wide-field microscopy, across an imaging depth range from 0 to 600 μm . We envision that our technique will find applications in imaging cells, tissues, and organisms, as well as other areas of the life sciences.

2. Requirement on input data

The sample is illuminated by sparse structured light fringes in two orthogonal directions using multi-step phase shifting to acquire multiple phase-shifted images.

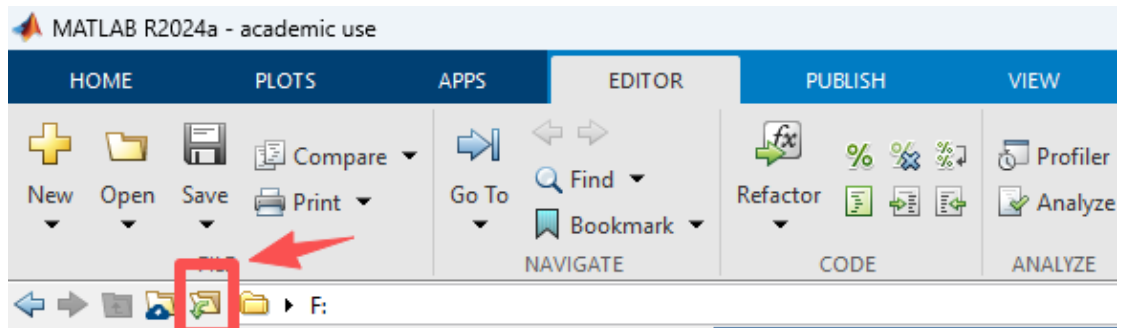
Recommended parameters: Fringe period: 2.4 μm ; Phase steps: 12.

3. Reconstruction steps

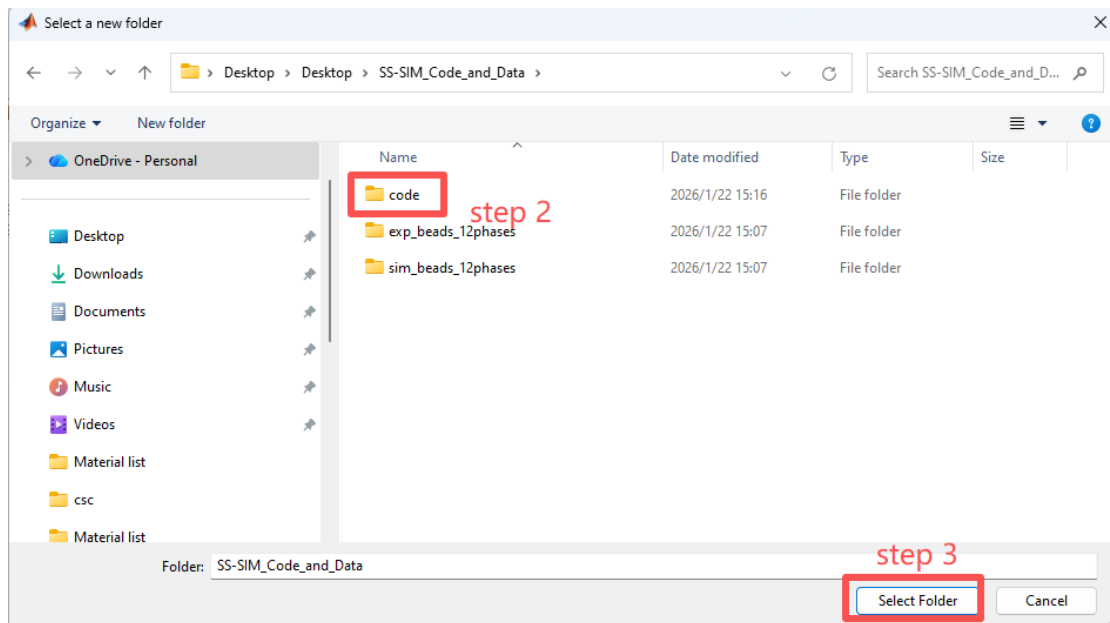
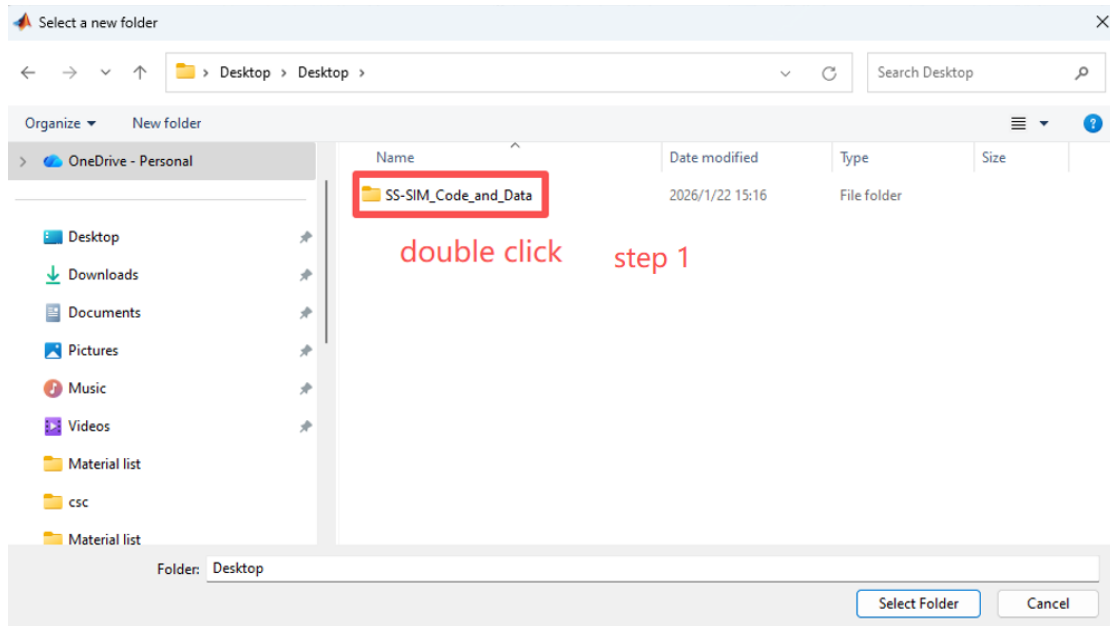
- (1) Start the Matlab software.



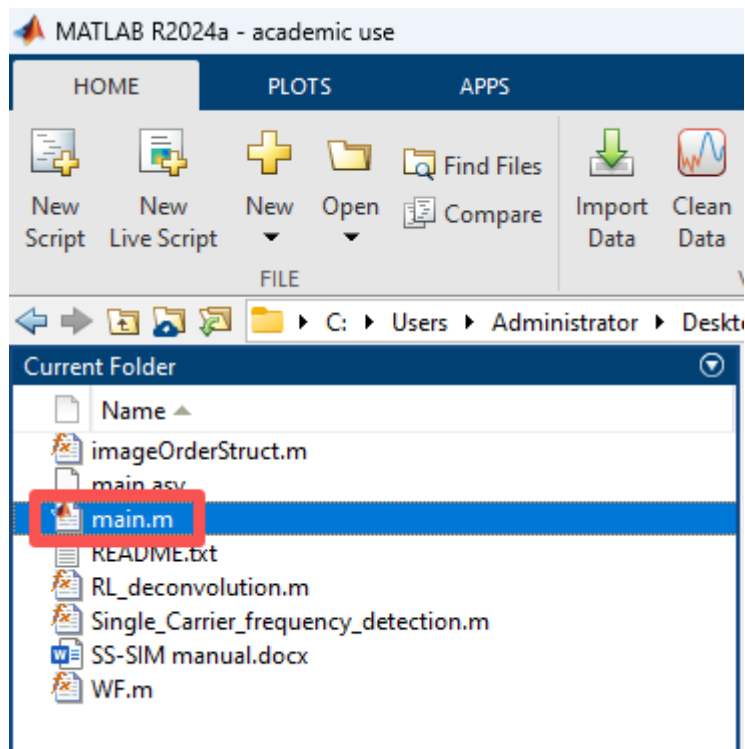
(2) Click the file browser button on the main interface.



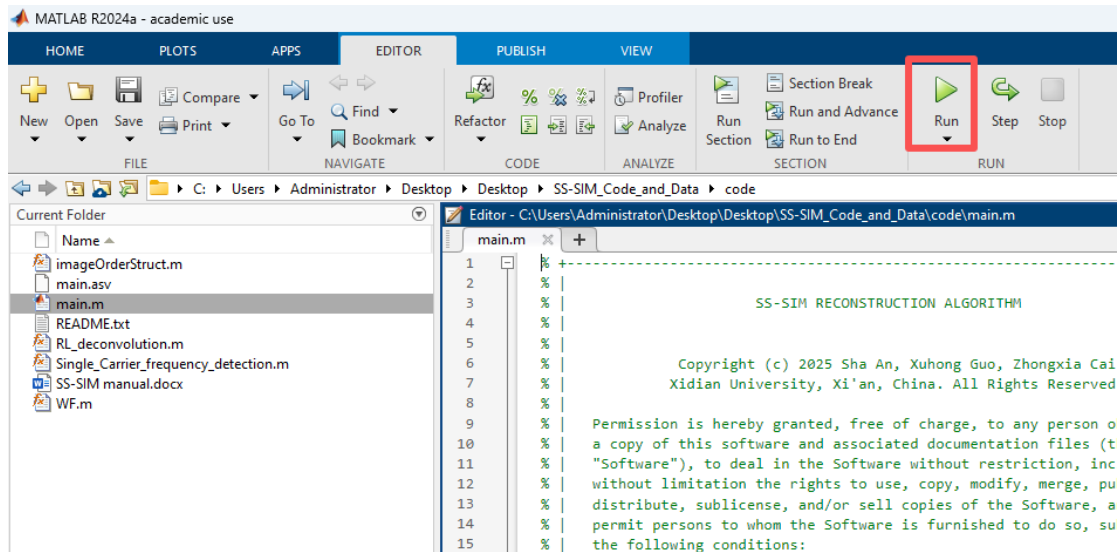
(3) Locate the folder containing the sample code in the file explorer.



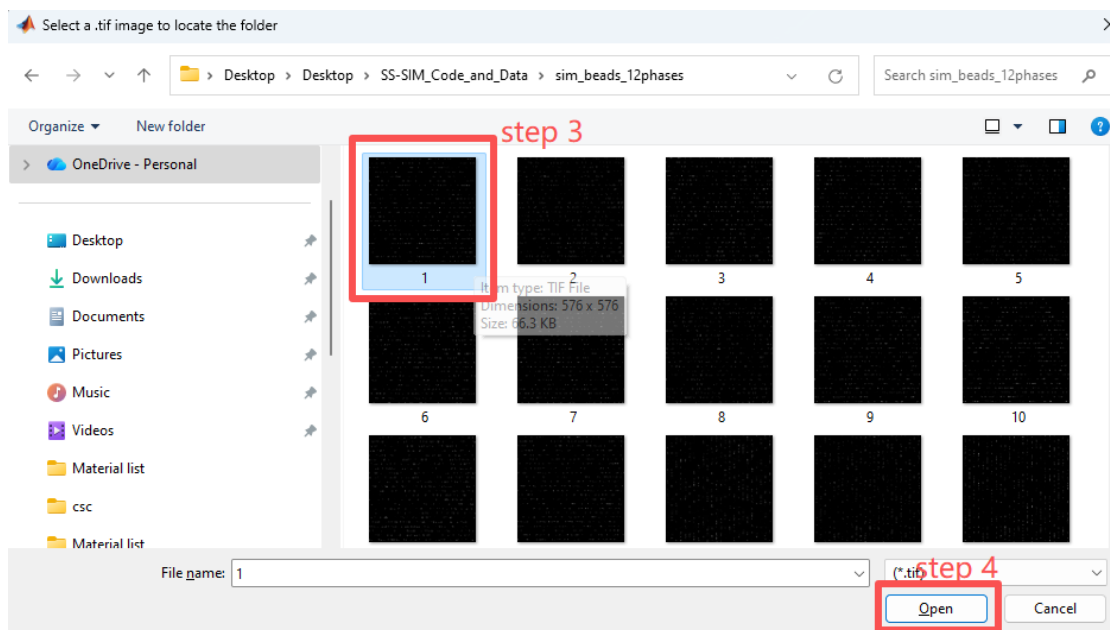
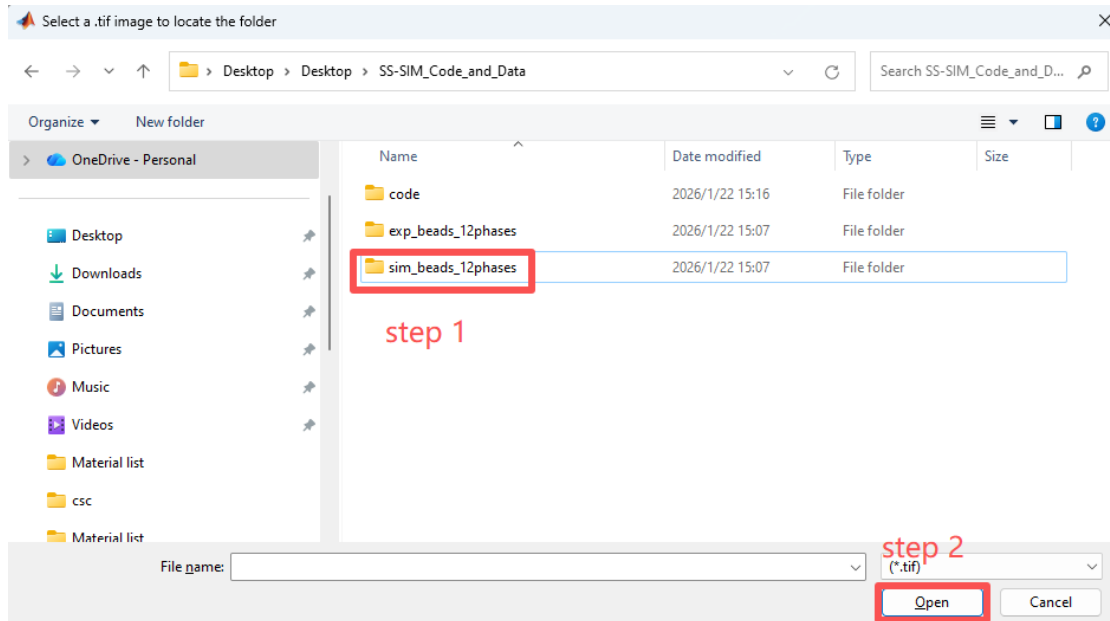
(4) Double-click main.m in the current folder.



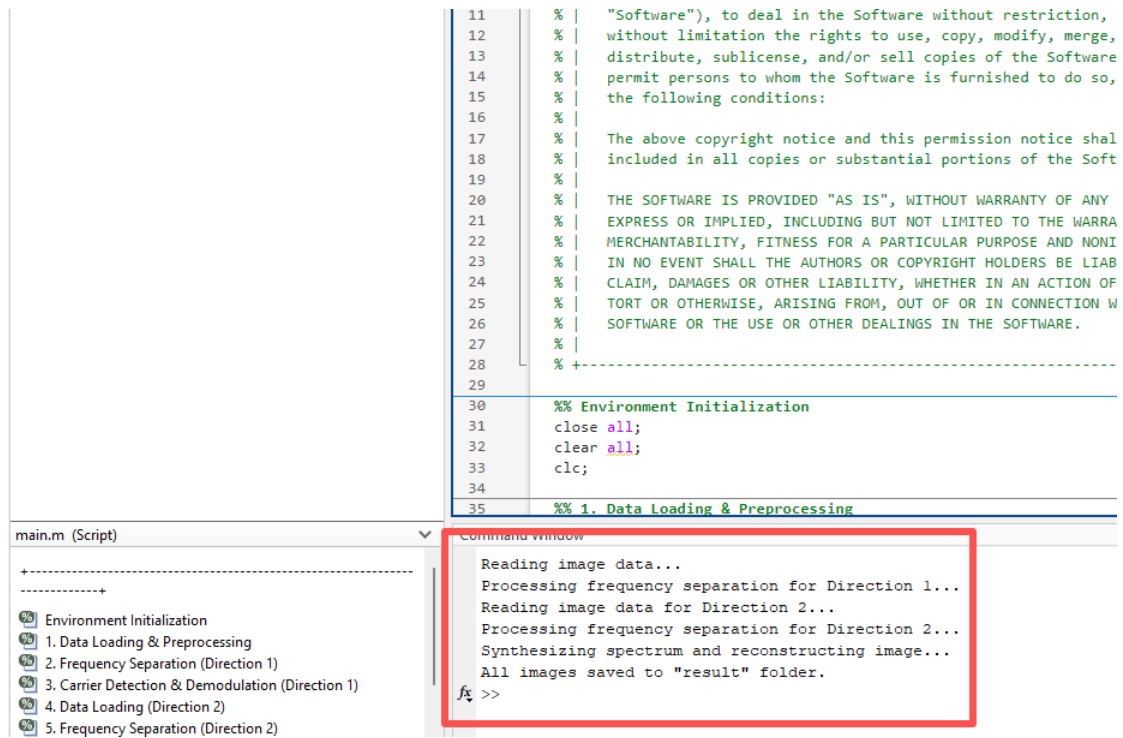
(5) Click the Run button.



(6) Perform the following operations according to the pop-up window.



(7) Wait for the code to finish running.



The screenshot displays the MATLAB environment with a script editor and a command window. The script editor shows lines 11 through 35 of a file named 'main.m'. Lines 11-29 contain a copyright notice. Lines 30-34 are for environment initialization, and line 35 marks the start of '1. Data Loading & Preprocessing'. The command window, titled 'Command Window', shows the execution progress of the script, with a red box highlighting the first five steps: Environment Initialization, Data Loading & Preprocessing, Frequency Separation (Direction 1), Carrier Detection & Demodulation (Direction 1), and Data Loading (Direction 2). The progress bar indicates that the script is currently executing step 5.

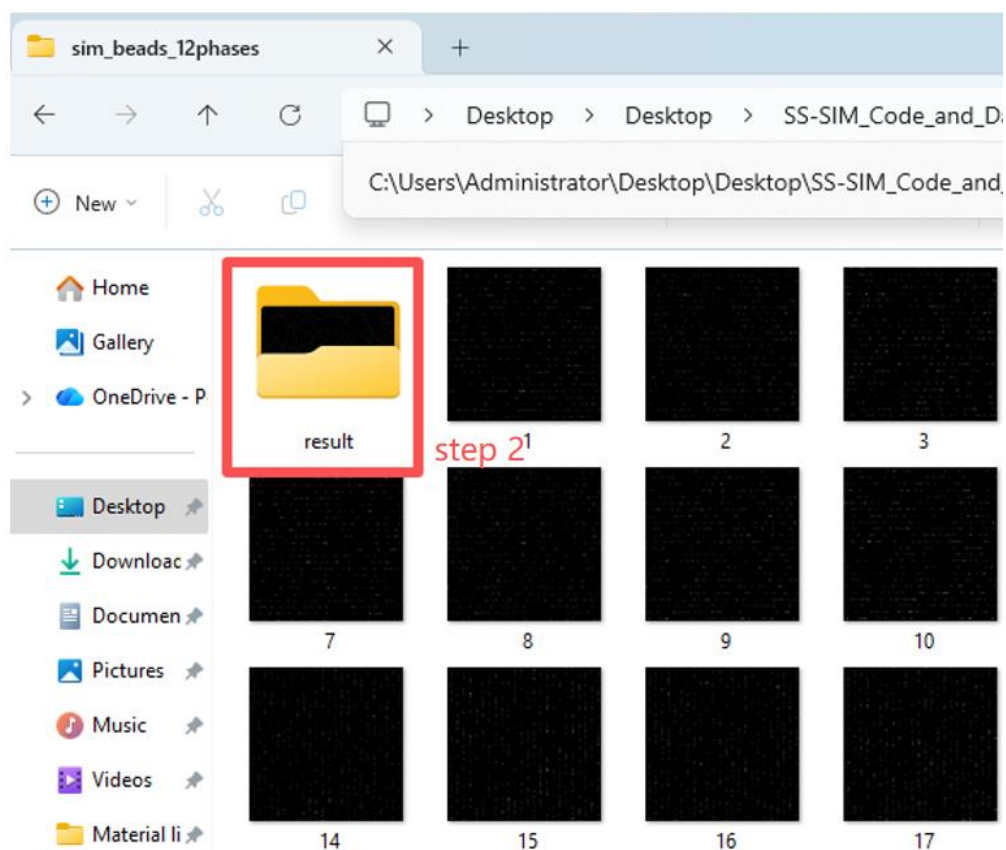
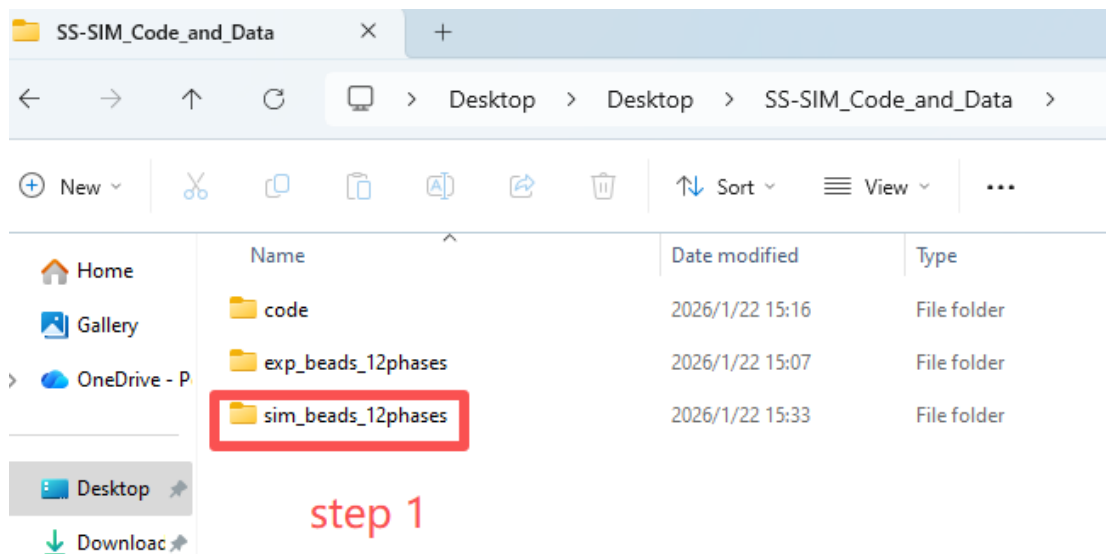
```
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27 % |  
28 % | +-----+  
29  
30 %% Environment Initialization  
31 close all;  
32 clear all;  
33 clc;  
34  
35 %% 1. Data Loading & Preprocessing
```

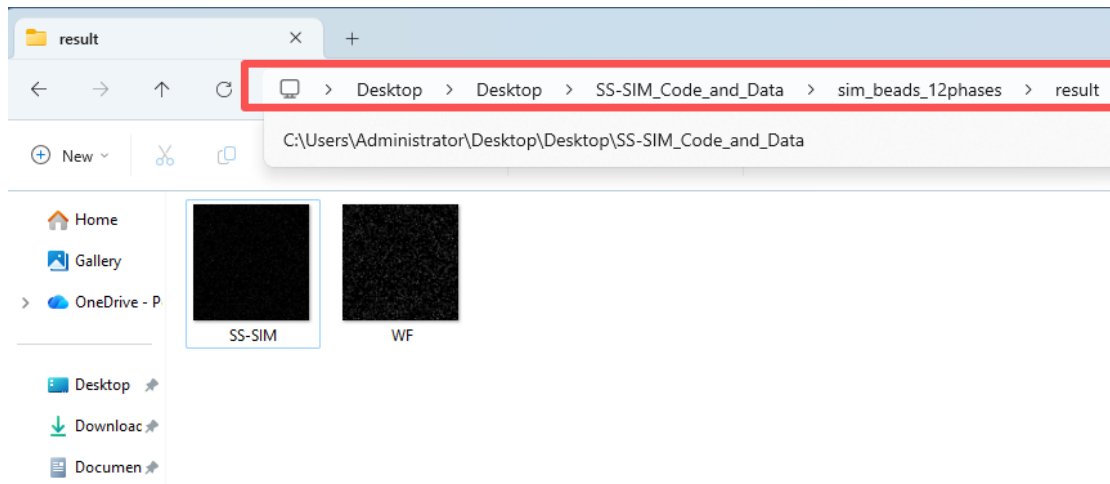
main.m (Script) Command Window

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+-----+
1. Environment Initialization
2. 1. Data Loading & Preprocessing
3. 2. Frequency Separation (Direction 1)
4. 3. Carrier Detection & Demodulation (Direction 1)
5. 4. Data Loading (Direction 2)
6. 5. Frequency Separation (Direction 2)

Reading image data...
Processing frequency separation for Direction 1...
Reading image data for Direction 2...
Processing frequency separation for Direction 2...
Synthesizing spectrum and reconstructing image...
All images saved to "result" folder.
fx >>

- (8) Open the folder where the program is located, find the result folder within the simulated data, and you will obtain the recovery results.





Note: Real data recovery is similar to simulated data recovery; you only need to select the experimental data folder.