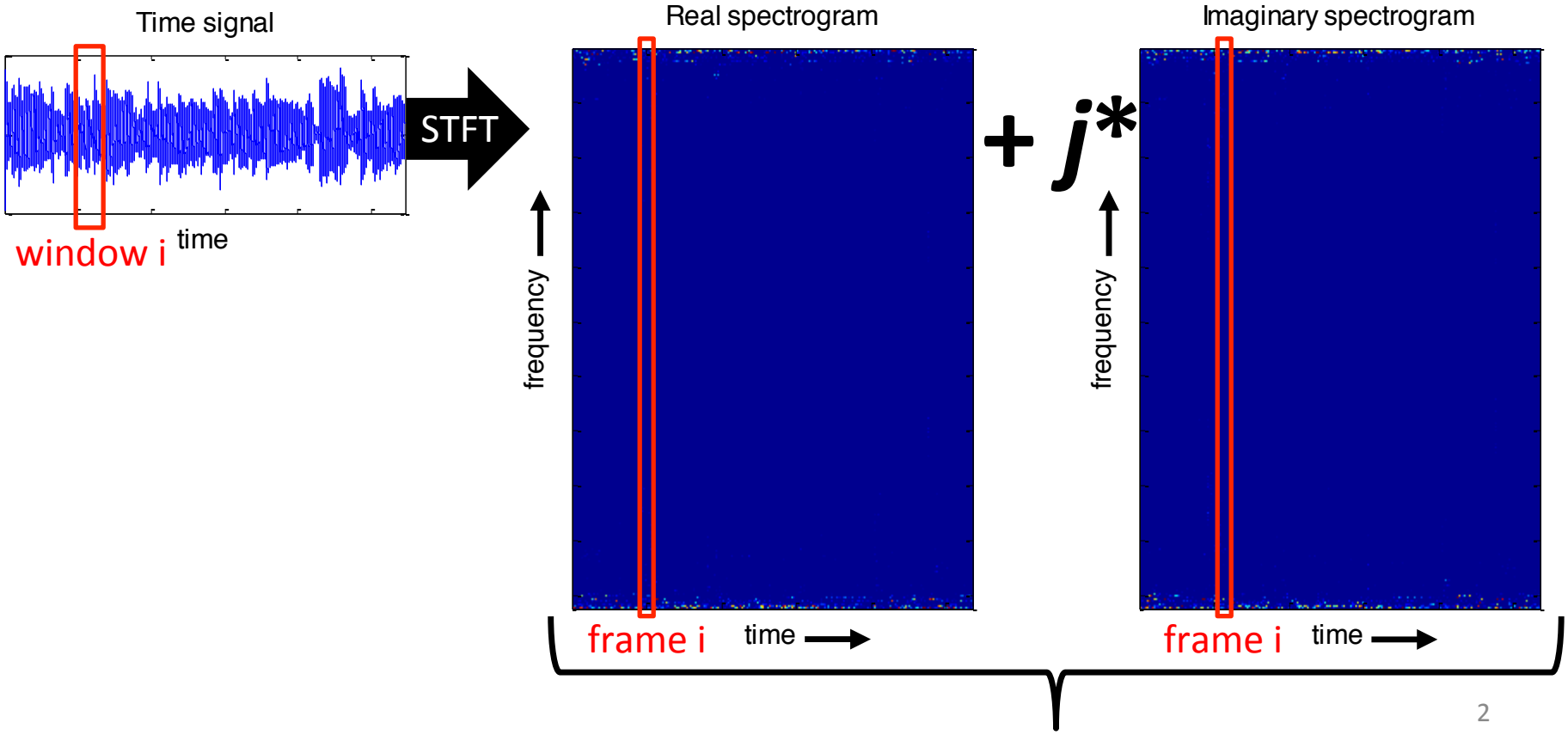
Short-Time Fourier Transform

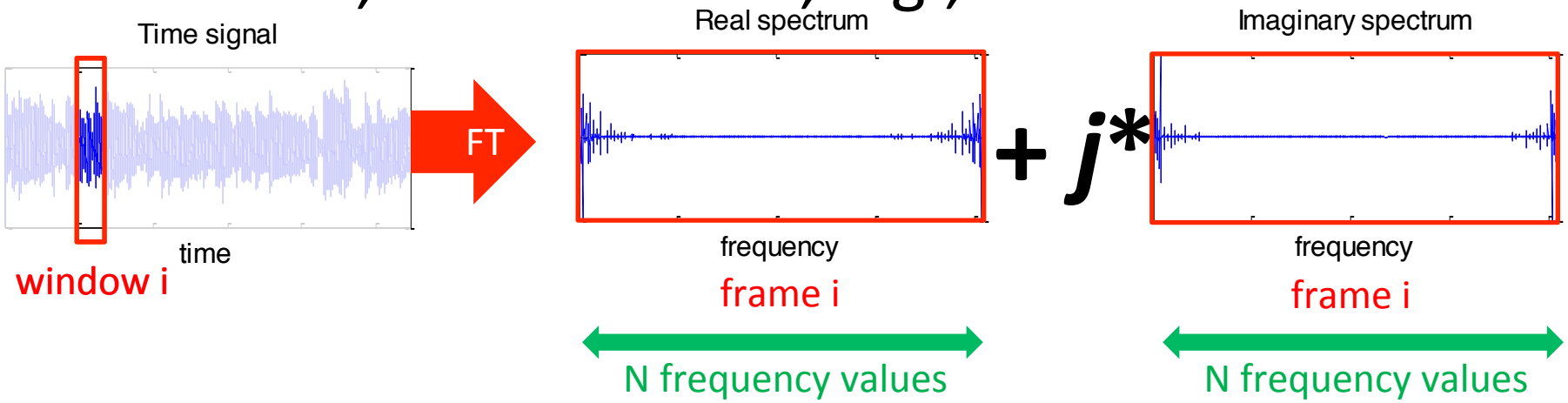
STFT

- The **Short-Time Fourier Transform** (STFT) is a succession of local Fourier Transforms (FT)



STFT

- If we used a window of N samples, the FT has N values, from 0 to N-1; e.g., if N = 8…



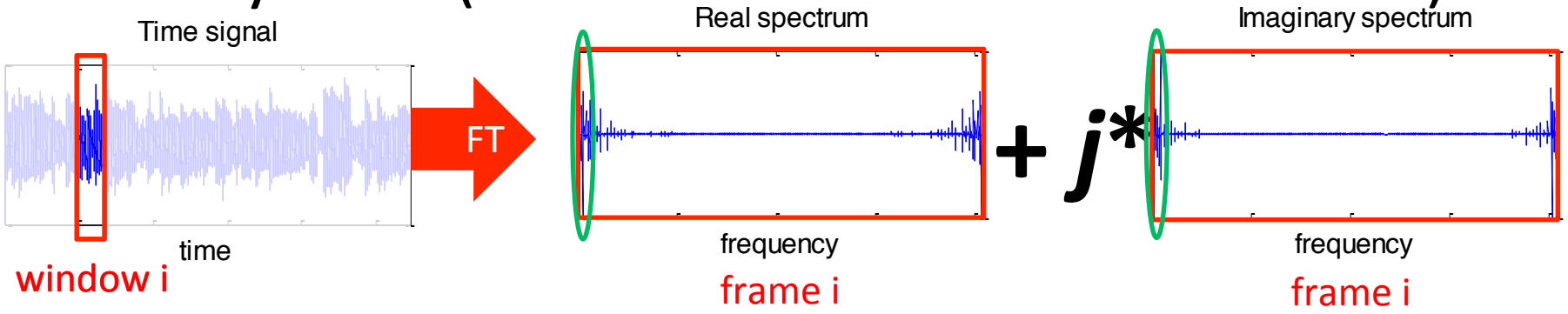
-3	-1	0	1	2	1	0	-1
0	1	2	3	4	5	6	7

+ j*

0	-1	0	1	0	-1	0	1
0	1	2	3	4	5	6	7

STFT

- Frequency index 0 is the **DC component**; it is always real (it is the sum of the time values!)



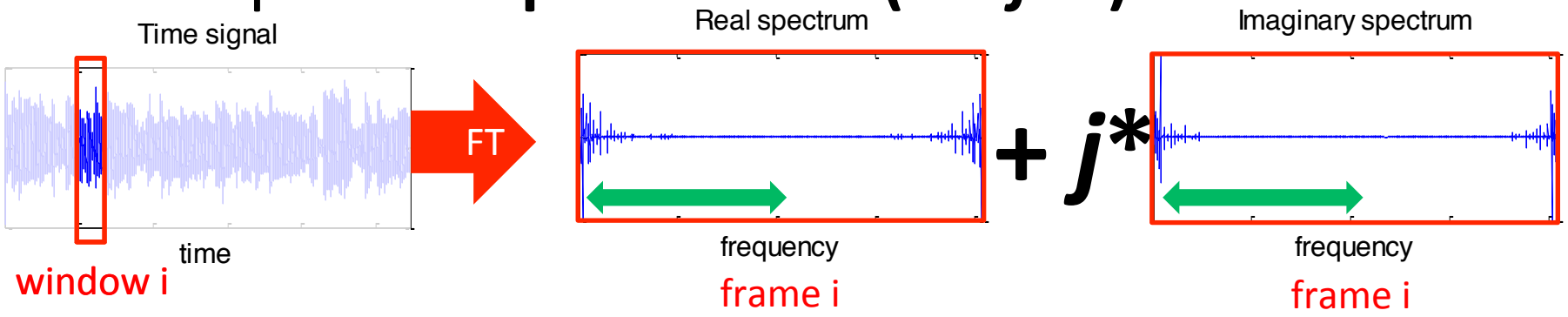
-3	-1	0	1	2	1	0	-1
0	1	2	3	4	5	6	7

+ j*

0	-1	0	1	0	-1	0	1
0	1	2	3	4	5	6	7

STFT

- Frequency indices from 1 to floor(N/2) are the "unique" **complex values (a + *j**b)**



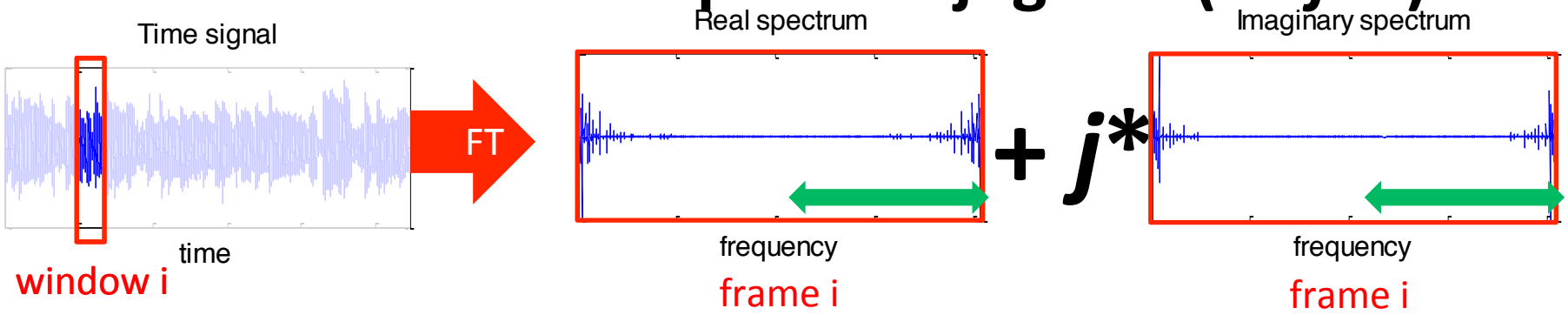
-3	-1	0	1	2	1	0	-1
0	1	2	3	4	5	6	7

+ *j**

0	-1	0	1	0	-1	0	1
0	1	2	3	4	5	6	7

STFT

- Frequency indices from floor(N/2) to N-1 are the "mirrored" **complex conjugates (a - *j**b)**



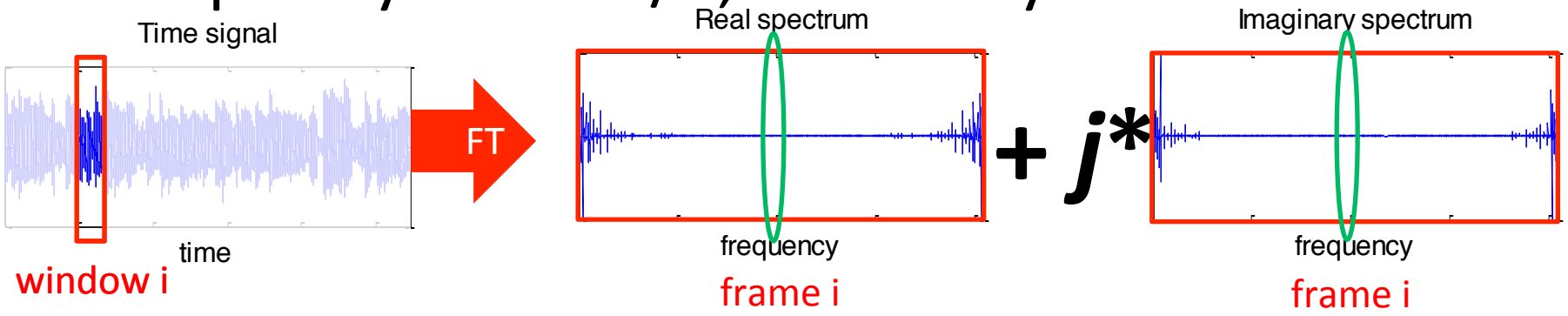
-3	-1	0	1	2	1	0	-1
0	1	2	3	4	5	6	7

+ *j**

0	-1	0	1	0	-1	0	1
0	1	2	3	4	5	6	7

STFT

- If N is even, there is a **pivot component** at frequency index N/2; it is always real!



-3	-1	0	1	2	1	0	-1
0	1	2	3	4	5	6	7

+ j*

0	-1	0	1	0	-1	0	1
0	1	2	3	4	5	6	7

STFT

- Summary of the frequency indices and values in the STFT (in colors!)

N frequency values =
frequency 0 to N-1

Frequency 0 =
DC component (always real)

Frequency 1 to floor(N/2) =
“unique” complex values

Frequency N/2 =
“pivot” component (always real)

Frequency floor(N/2) to N-1 =
“mirrored” complex conjugates