

I just realized that the complex fourier series is different from the real fourier series. Here is a video explaining the complex fourier series: <https://www.youtube.com/watch?v=aC0j8CW58AM>

The whiteboard shows the following steps:

$$f(x) = a_0 + \sum_{n=1}^{\infty} a_n \cos(nx) + \sum_{n=1}^{\infty} b_n \sin(nx)$$

$$= a_0 + \sum_{n=1}^{\infty} a_n \left( \frac{e^{inx} + e^{-inx}}{2} \right) + \sum_{n=1}^{\infty} b_n \left( \frac{-ie^{inx} + ie^{-inx}}{2} \right)$$

$$= \underbrace{a_0}_{c_0} + \sum_{n=1}^{\infty} \underbrace{\left( \frac{a_n - ib_n}{2} \right)}_{c_n} e^{inx} + \sum_{n=1}^{\infty} \left( \frac{a_n + ib_n}{2} \right) e^{-inx}$$

On the right, trigonometric identities are listed:

$$\cos \theta = \frac{e^{i\theta} + e^{-i\theta}}{2}$$

$$\sin \theta = \frac{e^{i\theta} - e^{-i\theta}}{2i}$$

A note with an arrow points to the second sum: "change n to -n". Below it, the sum is rewritten:

$$\sum_{n=-\infty}^{-1} \underbrace{\left( \frac{a_n + ib_n}{2} \right)}_{c_n} e^{inx}$$

He shows that the real fourier only needs summation from 1 to infinity while the complex is done in 2 parts: 1 to infinity and -1 to negative infinity while  $n = 0$  is neglected. I think this is why the  $n = 0$  term was ignored in the paper but how do I solve for  $a_0$  (or  $c_0$ )? You can see below that he ignores  $c_0$  term in the fourier series???

The close-up shows the following equations:

$$= \underbrace{a_0}_{c_0} + \sum_{n=1}^{\infty} \underbrace{\left( \frac{a_n - ib_n}{2} \right)}_{c_n} e^{inx} +$$

$$f(x) = \sum_{n=-\infty}^{\infty} c_n e^{inx}$$