In the name of God, the Most Gracious, Merciful
Subject:
Systems can be represented in the frequency domain instead of the time domain. This is achieved using the Laplace and Fourier operators. Examine the characteristics of representing systems in the frequency domain and the advantages it has over the time domain. Also, interpret the main differences between Fourier and Laplace representations using your engineering intuition.

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In this report, I am to provide an intuitive understanding of frequency based on my research and ideas. Since ancient times, humans have observed their surroundings and its patterns to understand the behavior and function of nature, or more broadly, space. Our ancestors managed to write laws in mathematical language for the understanding of themselves and future generations, which we now know as branches of classical physics like Newtonian mechanics and classical dynamics.

In order to have deeper understanding and operation, ancient scientists realized the necessity of a fundamental quantity called time. It is with time and its changes that we can calculate and express speed, acceleration, etc., qualitatively. Without it, all events would be described only descriptively. The concept of time continues to be a topic for discussion and theorizing among physicists, as we know it exists and is relative. This topic is explored in scientific and academic papers, so discussing it further suffices here.

With the introduction of periodic functions (a type of energy signals) and repeating cycles, the concept of the period became meaningful. The time for one cycle or period was defined as a period, i.e., how long does it take to complete one cycle? Now, if we look at it from another perspective, i.e., how many cycles occur in a specified time, we reach the concept of frequency, which in terms of units, is the inverse of time (Hertz). Since we are dealing with trigonometric and periodic functions, when we multiply frequency by 2*pi , it defines angular frequency. We then proceed to discuss frequency. By generalizing this subject, we introduce different types of frequencies in other sections, like angular frequency, and so on. Now let's examine what exactly the geniuses of history, Fourier and Laplace, did.

Considering the mathematical relations known from Fourier and Laplace (to optimize the content, formulas are not included), they show us that most functions can be expressed as a series of orthogonal trigonometric functions with different coefficients. This allows us to analyze the function in the frequency domain rather than in the time domain. This means that the system is specific and determined, but its behavior model depends on whether we have a time-domain or frequency-domain perspective.

The computational limitations or difficulties we encounter in the time domain are not observed in the frequency domain. An example of this can be seen in the properties of the Laplace transform, where differentiation, integration, or multiplication by an exponential function and so forth in the time domain transform to a coefficient S,1/S, frequency shift, etc., in the frequency domain. To optimize the content, the full properties are not mentioned, but the reasoning or simplicity behind each property can be explained.

Thank you for your attention.