

Millimeter-Wave Spectroscopy for Evaluating Blood Coagulation and Clotting

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Summary:

Millimeter-Wave spectroscopy is an emerging technology that has shown significant potential in medical diagnostics, particularly the measurement of blood coagulation is of crucial relevance in detecting stroke attacks. A promising approach is the utilization of dielectric changes in blood at frequencies in the 75-110 GHz range. This paper offers a novel approach to support and quantify the visualization of these biological processes.

Keywords: THz spectroscopy, medical, blood coagulation, blood clotting, PCA, FA

Introduction

Maintaining a healthy cardiovascular system is important for overall well-being. Millimeter-wave and THz signals exhibit a strong interaction with biological matter, which can be efficiently employed in biomedical applications due to the non-ionization properties of electromagnetic waves.

Measurement setup

The setup measures the absorption and reflection of THz radiation as it passes through a sample, to probe the molecular dynamics of blood components. Since these frequencies are highly sensitive to molecular vibrations and hydrogen-bonding interactions, they can provide detailed information about the structural and dynamic properties of biological molecules. In the context of blood coagulation, millimeter-wave spectroscopy can detect changes in the molecular structure of blood components as they transition from a liquid to a gel state during clot formation. The ability to determine the timestamp of clotting and detect the presence and effectiveness of blood thinners is vital for patient care. THz spectroscopy offers a powerful, non-invasive method for real-time monitoring of blood coagulation, providing valuable insights for both clinical diagnostics and pharmaceutical research.

The application of advanced algorithms for data analysis, including principal component analysis (PCA), has proven crucial for the interpretation of complex data sets, especially in medical diagnostics. This method allows the

dimensionality of the data to be adjusted and reduced into manageable components, making it easier to identify significant patterns indicative of blood clotting. A factor analysis (FA) allows conclusions to be drawn about the points in time at which something is happening and provide another level of interpretation.

Conclusion

The effectiveness of anticoagulant medications is assessed by measuring their impact on coagulation time. Blood coagulation during surgeries or in patients with clotting disorders can be monitored in real-time. By measuring changes in blood coagulation time, Millimeter-wave spectroscopy can help ensure that patients are receiving the correct dosage of blood thinners. Interactions between blood thinners and other medications that may affect coagulation are identified. The use of AI-supported algorithms can considerably increase the efficiency of coagulation measurement by determining and evaluating schemes in the biological signals.

References

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