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INFLUENCE OF SUBSTRATE MATERIAL ON THE CHARACTERISTICS OF A RHOMBIC PATCH ANTENNA

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This paper studies the influence of dielectric substrate materials (AD255C, FR4, FSD1020T) on patch antenna characteristics. Results show that increasing substrate height raises gain and axial ratio for AD255C and FR4, while for FSD1020T gain increases but AR decreases. AD255C demonstrated the best performance.

Keywords: patch antenna, planar antenna, reflection coefficient, gain, axial ratio.

Modern wireless communication systems, particularly 5G networks and subsequent 3GPP standards [1, 2], impose increased requirements on the efficiency and compactness of antenna systems. A critically important direction is the implementation of Direct-to-Device/Direct-to-Cell communication technologies [3, 4], which require high-performance and compact transceiver modules. Patch antennas remain one of the most preferable solutions because they are easy to manufacture and feature high degree of integration. The key element that determines the main characteristics of any planar antenna is the dielectric substrate. The substrate parameters, specifically the relative permittivity (ε_r) and thickness (h), have a significant impact on the frequency-dependent characteristics of the antenna. The aim of this study is to investigate the influence of different types of dielectric substrate materials on the characteristics of a patch antenna using electrodynamic simulation.

Structure, Materials, and Simulation Approaches. The simulation was performed in the CST Studio Suite electromagnetic simulation environment using the frequency domain solver. The calculation was carried out in the frequency range of 1–3 GHz with 10 frequency points. The external

boundaries of the computational domain were modeled as open space. The distance from the boundaries of the structure under investigation to the outer boundary of the computational domain along all axes was a quarter of the wavelength. The materials and geometric dimensions of the antenna element (AE) were as follows: relative permittivity (ε_r), copper thickness (t), dielectric loss tangent (tanΔ), and wavelength (λ), as presented in Table. Figure 1 shows the structure of the rhombic patch with its dimensions and electrodynamic model.

Materials and geometric parameters of the antenna element

Material	ε_r	t, mm	λ, mm	λ/2, mm	λ/4, mm	tanΔ
AD255C	2.55	0.035	89.4	44.7	22.35	0.0014
FR-4	4.6		66.56	33.28	16.64	0.035
FSD1020T	10.2		44.7	22.35	11.175	0.0028

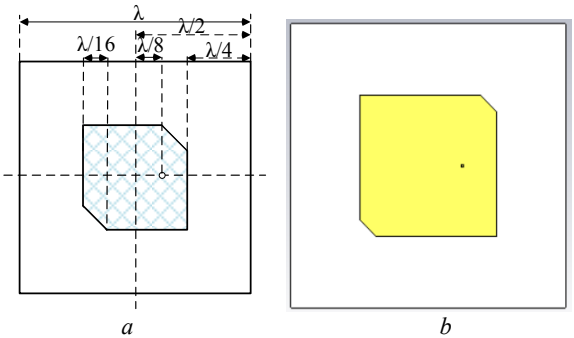

Fig. 1. Patch antenna dimensions (*a*) and its electrodynamic model (*b*)

Results. To evaluate the characteristics, simulations were performed with varying dielectric substrate heights, and their results are presented in Figs. 2–4.

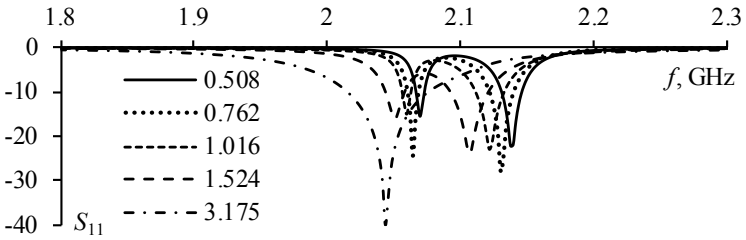

Fig. 2. Frequency dependence of S_{11} on h for AD255C

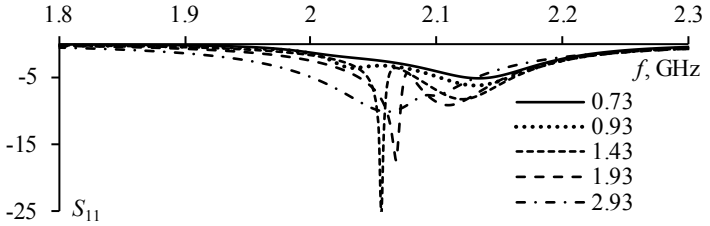

Fig. 3. Frequency dependence of S_{11} on h for FR-4

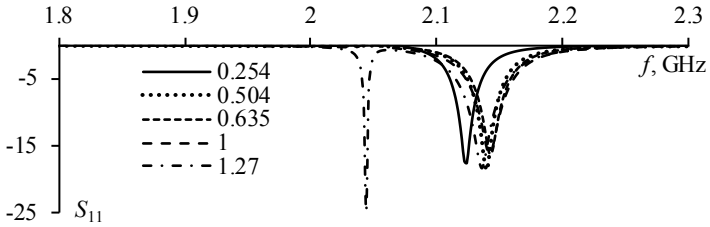

Fig. 4. Frequency dependence of S_{11} on h for FSD1020T

According to the results, when using AD255C, the distance between resonances and S_{11} increased. With FR-4, S_{11} was normal at h = 1.43 and 1.93 mm, and the second resonance was also less visible. With FSD1020T, an increase in h of above 1 mm led to the appearance of a second resonance.

Conclusion. Electrodynamic simulation was performed for various dielectric substrate materials. It was revealed that increasing h with AD255C led to an increase in the distance between resonances and higher S_{11}, as well as an increase in gain and axial ratio (AR). With FR-4, the results were acceptable for h ranging from 1.43 to 1.93 mm; for other heights, a less pronounced resonance was observed, and gain and AR also increased. With FSD1020T, increasing the height above 1 mm resulted in the appearance of a second resonance, an increase in gain, and a decrease in AR.

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ONTOLOGY-BASED PERSONALIZED COGNITIVE BEHAVIORAL PLANS FOR WELL-BEING

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This paper presents an ontological model of personal well-being based on principles of cognitive behavioral therapy to generate individualized user plans for a mental health mobile application. The ontology structures key concepts including psychological indicators, internal factors, and therapeutic tools. Inference rules enable personalized exercise recommendations based on user assessment data, addressing limitations of standard applications, and LLM-based approaches.
Keywords: ontology, semantic model, well-being, cognitive behavioral therapy, m-health.

Mental health problems are one of the leading causes of disability in the world [1]. However, barriers prevent people from seeking professional help in a timely manner. Mobile applications is a tool to increase the availability of psychological help. Structured cognitive behavioral therapy (CBT) methods are a common therapeutic framework for such applications. At the moment, standard applications offer the user a specific set of exercises. The order of the exercises remains at user discretion, or is prescribed by a psychologist if the application is used in therapy.

Large Language Models (LLM), many of which are ready to play the role of a psychologist, solve this problem. However, since LLMs do not take into account the context of the user's entire life, they can, on the contrary, contribute to the development of disorders in the user. Ontological decision support models are widely used to solve this problem [2–4]. Developing existing approaches, this work proposes an ontological model of personal well-