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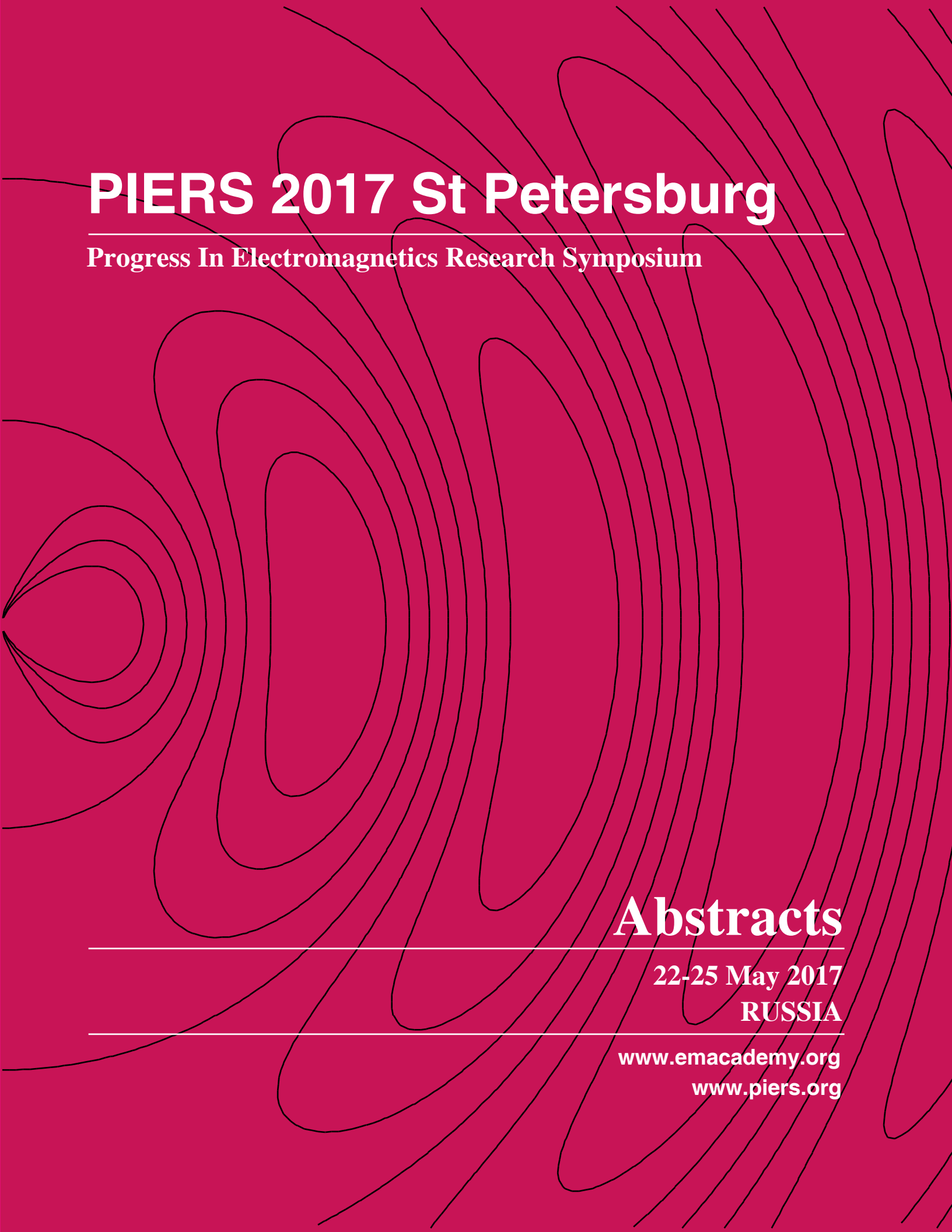

Abstracts

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Application of Transmission Line-based Inductors to Dual-band Branch Line Couplers

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Abstract— In many cases, arbitrary lumped element values are required for refined performances with a good improvement of RF and microwave circuits. However in practice, predefined or quantized lumped elements such as chip capacitors and inductors are provided because of some industrial-background reasons like cost, mass production, and industrial standard system. So compromised lumped element values are adopted by designers with a trade-off between required ideal performances and practically obtainable ones. In this work, a method is discussed to overcome this problem by focusing on the realization of arbitrary inductance values with high-impedance transmission line and capacitors. An inductance L shown in Fig. 1(a) can be replaced by a transmission line at the design frequency with the line impedance of Z_{c1} and electrical length of θ_1 as in Fig. 1(b). In addition, when a capacitor (C) is connected to a transmission line with Z_{c2} and θ_2 as in Fig. 1(c), this combination also acts like a inductor at the design frequency. Calculating and comparing three input impedances (Z_{in}, Z_{in1}, and Z_{in2}), it is clear that an arbitrary inductance value can be obtained by selecting proper line impedances (Z_{c1} and Z_{c2}), length (θ_1 and θ_2), and capacitor value (C). Furthermore, this arbitrary inductance value can be controlled continuously by adjusting Z_{c1}, Z_{c2}, θ_1, θ_2, and C. Fig. 2 shows an example of the calculated equivalent inductance values of Fig. 1(b) by adjusting θ_1, for a fixed Z_{c1}. It is well understood that arbitrary inductance values can be provided with a good continuously-varying property. In this work, this property is applied to design of dual-band stubs, and further, dual-band branch line couplers using CRLH (composite right/left handed) transmission lines. Fig. 3(a) and Fig. 3(b) illustrate the dual-band studs composed of ideal CRLH sections and practically realizable high impedance lines. Fig. 3(c) proves that the required dual-band properties are well

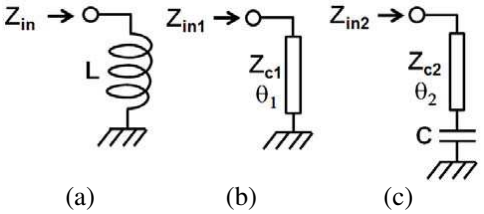

Figure 1.

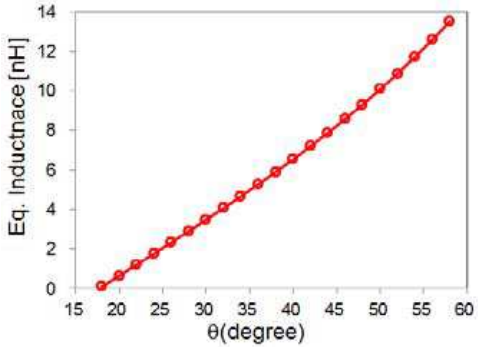

Figure 2.

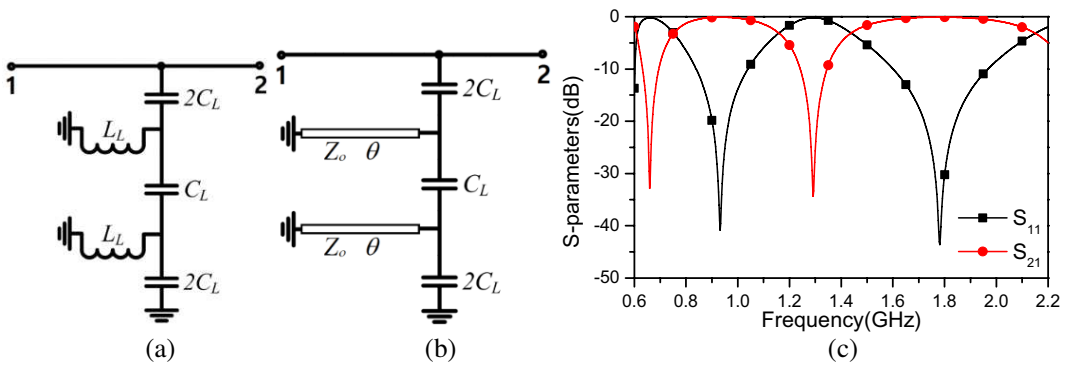

Figure 3.