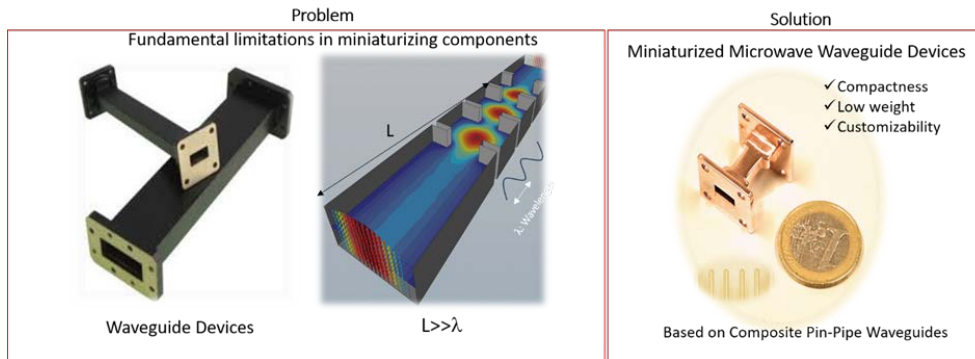


Miniaturized Microwave Waveguide Devices

Application to Space and Terrestrial Microwave and Millimeter-Wave Systems



Comparison between traditional and pin-pipe waveguides (PPW)

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Description

Space and terrestrial communication infrastructure demand low-cost and reduced-size components. Microwave passive components are the essential parts of communication systems, which split, combine, filter, attenuate, shift the phase, or change the polarization of microwave signals. Among different technologies for constructing microwave devices, the hollow metallic waveguides play a vital role in antenna feed components. Although the waveguide technology comprises no frequency or power limitation, the large volume and high weight are the core drawbacks of the waveguide devices, especially for space applications.

To reduce the size and weight of microwave waveguide passive devices, such as waveguide filters, the invention of pin-pipe waveguides (PPWs) aims at employing locally resonant metamaterials to manipulate waves at subwavelength volumes, compatible with standard waveguides.

Advantages

The proposed design framework of PPWs overcomes the physical size limitations to construct, for example, a **compact waveguide filter 10 times smaller** than conventional filters. Besides, the footprint size is decoupled from the operating wavelength, and the bandwidth is adjustable, which is a remarkable feature. The adjustability of operating frequency and bandwidth in this invention, combined with high-resolution additive

manufacturing, enables us to provide custom waveguide devices for frequencies in the range of 2-40GHz, and bandwidths from 3% to 75%. This invention is used to construct microwave filters, multiplexer, and dual-band filters, with coaxial and standard waveguide ports. The proof of concept results, obtained for WR75 (10GHz) and WR28 (30GHz) waveguides, demonstrate the compactness, customizability, and high rejection level of the invented microwave devices.

Supported by the EPFL [enable](#) grant, the manufacturing of various components and the experimental investigations is ongoing to assess the invention's capability and improve the fabrication and post-fabrication techniques.

Applications

- Space systems:
 - Small GEO Satellites
 - SATCOM
 - Broadcasting
 - LEO & MEO Satellites
 - 5G
 - M2M / IOT
 - SAR Monitoring
- Terrestrial systems:
 - Very Small Aperture Terminals
 - Radars

Offering

- Licensing and / or collaboration
- Technology evaluation by potential customers