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In situ characterization of qubit control lines: A qubit as a vector network analyzer.

One of the factors limiting the fidelity of entangling gates in superconducting circuits are control signal distortions arising from non-trivial transfer functions of microwave lines. Distortions can be cancelled, in principle, if the complex transfer function of the control line is known, by applying its inverse to the signal before it is transmitted. We have proposed and experimentally realised a method of in situ direct reconstruction of the response of a control line of a qubit in large frequency range using the qubit itself, thus employing it as a VNA. In this talk I will explain the principles underlying our method and describe the experimental procedure allowing to characterise the 'flux' control line of a superconducting Transmon qubit in the range from 1 to 450 MHz. I will also show its experimental application to improve the fidelity of CPHASE gate between two superconducting transmon qutrits, which is the most common way to generate two-qubit operations in superconducting quantum processors.