Relation between the dynamics of a single-delay system and a feed-forward ring

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We reveal the relation between the dynamics of a single oscillator with delayed self-feedback and a feed-forward ring of such oscillators. In the ring, each unit is coupled to its next neighbor in the same way as in the self-feedback case. It is shown that periodic solutions of the delayed oscillator correspond to families of rotating waves with different wave numbers in the ring. In the particular case when the periodic solution of the single oscillator is rationally related to the delay, it can be embedded into a ring with instantaneous couplings. In several cases also the stability of the periodic solution for the single unit can be related to the stability of the corresponding rotating wave in the ring.

As a specific example we consider a ring of oscillators with instantaneous pulse coupling and demonstrate the scenario of simultaneously emerging jittering rotating waves. We show how these complex waves can be transferred from the so-called multijittering regimes in a single oscillator with delayed pulse feedback. The theoretical findings are corroborated by an experimental realization of this dynamical phenomenon in a system of coupled electronic circuits of FitzHugh-Nagumo type.