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Resonant drift of autowave vortices in two dimensions and the effects of boundaries and inhomogeneities. (English) Zbl 0925.92022

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Summary: The effect on autowave vortices in $\mathbb{R}^2$ of a non-localized, periodic external forcing with a near-resonant frequency is investigated, and the effects of boundaries and inhomogeneities in the medium and mutual interaction between vortices is explored. We adopt an asymptotic approach which results in a phenomenological description of the resonant drift in terms of ODE's for the location of the vortex core and its rotation phase. We compare the results predicted by the theory with numerical simulations. The behaviour of the vortex is more complicated than the resonant drift described by Davydov et al. [*V. A. Davydov*, *A. S. Mikhailov* and *P. K. Brazhnik*, "Kinetica i gorenie", p. 39, Institute of Chemical Physics, Chernogolovka (1986) (in Russian); *V. A. Davydov*, *V. S. Zykov*, *A. S. Mikhailov* and *P. K. Brazhnik*, "Drift and resonance of spiral waves in distributed media", Izv. Vuzotv-Radiofizika 31, 547-582 (1988)] and Agladze et al. [*K. I. Agladze*, *V. A. Davydov* and *A. S. Mikhailov*, "An observation of resonance of spiral waves in distributed excitable medium", Pis'ma v ZETP 45, 601-603 (1987)]. In particular. a resonantly drifting vortex can be repelled from a boundary (phenomenon of 'resonant repulsion'). Possible applications of resonant drift in the control of cardiac arrhythmias are studied. In particular, an approach for overcoming the resonant repulsion is proposed, which involves a feed-back from the medium to the stimulation device. We show that with this technique, the voltage needed for extinguishing vortices can be an order of magnitude less than that needed for the traditional single-pulse defibrillation.

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