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Phase Anticipating in Two Forced Self-Sustained Oscillators

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Keywords: anticipating phase synchronization, self-sustained oscillations, nonlinear dynamics, coupling design, periodically forced systems.

This paper demonstrates the effect of anticipating phase synchronization in two simultaneously periodically forced unidirectionally coupled nonidentical self-sustained oscillators. In our later work [1], we have detected a simple way for the prediction of chaotic dynamics. It relies on the phenomenon of phase synchronization [2]. In this paper, the authors have considered the case of *mutual coupling* between two chaotic oscillators and demonstrated that their phases may lock at a sufficiently large coupling strength. Contrary to this, we have considered the case of *unidirectional coupling* in the drive-response configuration. We have shown that the phase synchronization may appear in such a way that the phase of the response system outruns the phase of the drive system provided the response system is faster then the drive. We have demonstrated that this effect takes place in unidirectionally coupled chaotic Rössler oscillators [3] without any delay in either a drive system or a coupling term.

In this paper the phenomenon of the anticipating phase synchronization is applied to predict the dynamics of the periodically driven self-sustained oscillator. The efficiency of the drive-response scheme is studied analytically using a simplified averaged equation. This investigation has enabled us to estimate the critical value of the coupling strength when the phenomenon of the anticipating phase synchronization takes place. The numerical simulations of the dynamics of unidirectionally coupled nonidentical nonlinear systems, Van der Pol oscillators, have justified the analytical results. Provided the response system is faster then the drive the forecasting of the dynamics of the periodically forced self-sustained oscillator was performed.

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