Effects of degree-frequency correlations on network synchronization: Universality and full phase-locking

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• 05.45.Xt – Synchronization; coupled oscillators
• 89.75.Hc – Networks and genealogical trees

– We introduce a model to study the e ect of degree-frequency correlations on synchronization in networks of coupled oscillators. Analyzing this model, we find several remarkable characteristics. We find a stationary synchronized state that is i) universal, i.e., the degree of synchrony, as measured by a global order parameter, is independent of network topology, and ii) fully phase-locked, i.e., all oscillators become simultaneously phase-locked despite having di erent natural frequencies. This state separates qualitatively di erent behaviors for two other classes of correlations where, respectively, slow and fast oscillators can remain unsynchronized. We close by presenting an analysis of the dynamics under arbitrary degree-frequency correlations.

Introduction. - 1 4]. . fl fi fl 5], 6], 7], 8], -

(ω) . 12]

(24).

fl -

- -

α . (1) (2)

$\mapsto$ α $\mapsto \alpha$. $\alpha = 1$

fi .

,],

β.

$\beta = 1$, β 1, β 1 ,

- , - , .

,

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, fi

, fi $\psi_n =$

$\sum$ θ_m, ψ .

fi $= N^{-1} \sum$ $\frac{n}{n}$

.

Description of solutions. fl

-

fi . (1) (2).

.

fi . 1 -

( ) 22] $N = 1000$

$= 0.1$, $\beta = 1$. 1( )

, -

1, . , -

$= \ _1 \approx 0.2$,

$= \ _2 \approx 2$ ( ).

-

13].

A fi . 1( ),

( ), ( ),

( ) . $_1$, ≈ 0

,

. $_1$ $_2$,

.

( ), fi . 1( ).

$\rho(\theta)$

( ) (e.g.,

fi . 1( ), ,

fi . 1( ) fi . 1( ). ( )

( )

(-). ,

, - ( ) ≈ 1 (fi . 1( )).

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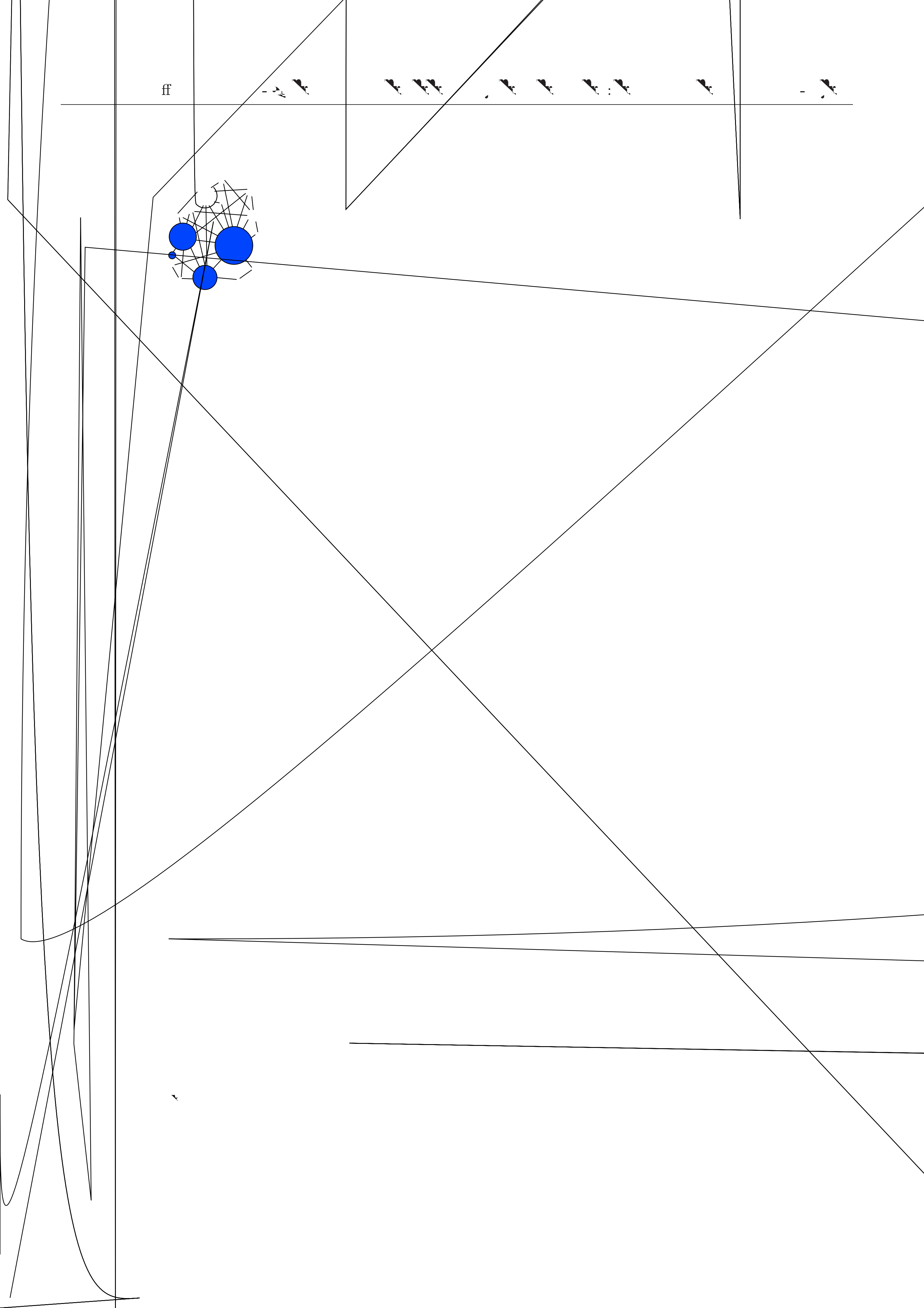
, ,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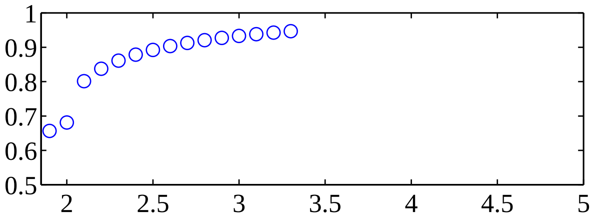
1
0.9
0.8
0.7
0.6
0.5
2
2.5
3
3.5
4
4.5
5

ff $(\beta = 1)$

fi . 2

General correlations. fi

fi

(i.e., . (2)),

. ψ ψ ψ ψ .

ψ