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thickness. We also found that the dynamical scaling property of the surface satisfies the scaling ansatz W~f(t/L^z) with the dynamical exponent z=1. When the attractive bias exists, the surface roughness increases logarithmically with size.

F-P010 **Nonlinear Dispersion Relationship and Mode-locking Phenomenon from Cardiac Waves in an In Vitro Experimental System** HWANG Seong-min, LEE Kyoung Jin(*Center for Neurodynamics and Dept. Physics, Korea University.*) Cardiac tissue is a typical example of biological excitable medium that can support nonlinear wave propagation. Using quasi-two-dimensional tissues of quiescent (i.e without any spontaneous pattern) primary cardiac cell culture that are maintained at 36°C, 5% CO_2 and 100% relative humidity, we have investigated dynamical properties of cardiac waves in vitro. Localized electrical stimulations (trains of 10 ms, 3 to 4-volt pulses) of various frequency are applied to the tissues and the subsequent responses are acquired via phase contrast optical mapping and analyzed. We find that dispersion relation of the cardiac waves is qualitatively identical to that of general excitable media. As the stimulation frequency is increased above a critical value, the medium starts failing to respond to the stimulus every now and then, hence creating complex sequences of beats. The beat-skipping events become more frequent as the frequency of the stimulation increases, and we found various mode-locked states therein.

F-P011 **Effect of the Coupling Range on the Occurrence of Partial Synchronization** LIM Woochang, KIM Sang-Yoon(*Department of Physics, Kangwon National University.*) We study the dynamical mechanism for the partial synchronization in four coupled one-dimensional maps by varying a factor w ($0 \le w \le 1$) which continuously tunes the "weight" in the next nearest-neighbor coupling from the nearest-neighbor local coupling (w=0) to the global coupling (w=1). As the coupling parameter ϵ decreases and passes a threshold value ϵ^*, the fully synchronized attractor on the diagonal loses its transverse stability, and then a blowout bifurcation occurs. Consequently, partial synchronization takes place on an invariant plane for the case of nearest-neighbor coupling with w=0. However, as w increases and passes a threshold value w^*, a transition from partial synchronization to complete desynchronization occurs. Thus, for $w^* < w \le 1$, a fully desynchronized attractor, occupying a finite 4D volume, appears. The mechanism for the occurrence of partial synchronization is discussed through competition between the laminar and bursting components of the intermittent two-cluster state born via the blowout bifurcation.

F-P012 **Band-Merging Route to Strange Nonchaotic Attractors in Quasiperiodically Forced Systems** LIM Woochang, KIM Sang-Yoon (*Department of Physics, Kangwon National University.*) We investigate the mechanism for the band-merging route to strange nonchaotic attractors (SNAs) in the quasiperiodically forced logistic map. Using the rational approximation to the quasiperiodic forcing, it is shown that a band-merging transition from a two-band smooth torus to a single-band intermittent SNA occurs via a phase-dependent saddle-node bifurcation when the smooth torus collides with a ring-shaped unstable set which has no counterpart in the unforced case. This mechanism for the band-merging transition to SNAs is also confirmed in the quasiperiodically forced Henon map, Toda oscillator, and neural oscillators. Hence, the band-merging route to SNAs seems to be "universal," in the sense that it occurs through the same mechanism in typical quasiperiodically forced period-doubling systems of different nature. In addition to inducing the transition to SNAs, such a band-merging mechanism is also a direct cause for the truncation of the torus-doubling sequence.

F-P013 **흰색 콜리플라워의 프랙탈 차원** 김상훈(*목포해양대학교, 교양교수부.*) 흰색 콜리플라워의 단면을 잘라 상자세기 방식으로 프랙탈차원을 구한 후, 이로부터 덩어리 콜리플라워의 프랙탈차원을 유추하여 대략 2.78을 얻었다. 콜리플라워의 단면에 대한 수학적 모형을 단 하나의 축척계수만을 가진 4각수로 그리고, 이 모형이 프랙탈을 형성할 수 있는 조건을 구했다. 또한 이 사각수 모형과 콜리플라워의 단면을 측정하여 얻은 프랙탈 차원을 비교하여, 단면의 축척계수와 이 축척계수를 가진 사각수 모형의 사이각 등을 얻었다.