From inverted hysteresis to the overunity oscillator

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inverted hysteresis as an basic overunity effect

In NET-Journal 11 (3/4) 2006 F. Wiepütz [1] published about inverted hysteresis as a possible physical basis for an overunity technology. His article may be important from a principal point of view however it contained illustrating examples which are not practical for technical applications. If one asks today Google for "inverted hysteresis" or "inverse hysteresis" at least three pages of links are listed - some of them contain a clear experimental evidence for this effect and especially one system seems to be of bigger practical technical relevance which we will discuss here in this article including some technical consequences.

The state of art for inverted hysteresis systems

Wiepütz reported about a magnetic layer system of Ha et al.[2] which seemed to show a small inverted hysteresis effect. In the meantime this system has been criticized by some colleagues of Ha et al. from the same university [3]. They point out that inverted hysteresis violates the second law and show that the measurement with a vibrating sample magnetometer (VSM) may be an artifact due to a sloppy positioning of sample. They prove that the smaller the reaction of the sample the more easily this artifact can be obtained.

Nevertheless, Chang[4] and especially Chioncel and Haycock repeatedly [5] [6] published articles about a similar Co layer systems exhibiting a much stronger effect if compared with the most other known system not mentioned here. Contrary to Ha et al. the experimental expertise of [6] seems to be higher: they have a controllable home made instrument, and they describe all necessary experimental precautions for these measurements. And contrary to Ha et al.[2] they know very well that their system seems to violate the second law. Compared to other groups their VSM is able to turn the position of the sample in the apparatus. The most striking measurements with the 'best' probe are shown in fig. 1. It is funny that after a rotation of 180 degree the qualitative appearance of the hysteresis changes radically. Because the sample cannot see any difference in the exciting magnetic fields in the measuring cycle due to this change of position it is clear that the magnetic behaviour cannot change due to this change of position in the magnetic field. Therefore, the cause may be the dynamics of the system or another field perceived by the sample. It may be of elastic, gravity or electric

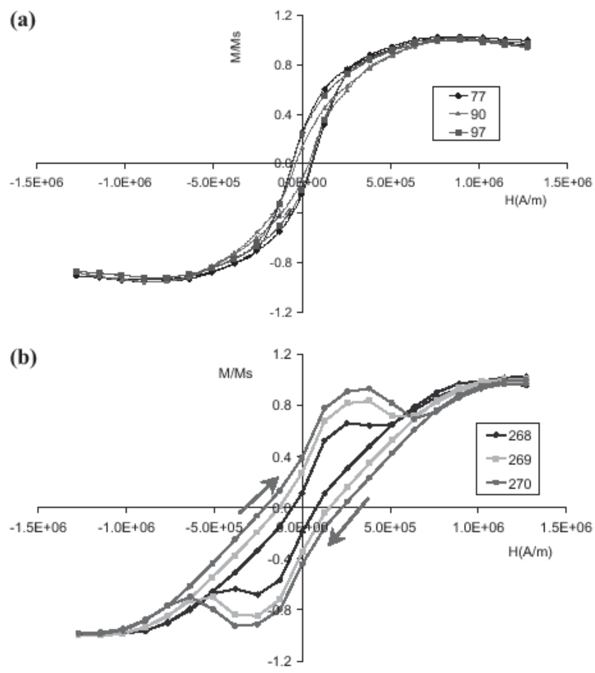

Fig.1: magnetisation vs. magnetic field for the Co-layer system of [6]
the box contains the angle of the sample in the field, the inverted hysteresis cannot be seen after a 180° turn-around of the sample in the H-field; the cause may be another symmetry-breaking field, cf. text

nature. The question is open so far. However, not only magnetic layer system can show an inverted hysteresis effect. There exist some magnetic bulk systems as well. One system has been published by the geophysicists Kosterov et al [7] . The method of measurement here is a AC- susceptibility measurement which is applied at different constant offset magnetic fields. The substance measured is polycristalline rhodochrosite (Manganese carbonate). The inverted hysteresis is found between 25 and 36 K. The saturation of the hysteresis curve is not given in their reference. The system is only of principal importance but is of course not very practical . Nearer to a technical application seems to be the system of Zivkovic et al. [8]. This international collaboration describes the magnetic behaviour of a Ruthenocuprate , i.e. an electric isolating ceramic substance very nearly related to the cuprate superconductors. The inverted hysteresis for this substance is found at 80 K . The saturation of the hysteresis is measured about 100 Oe and it appears only if the system is driven into the metastabile state. Due to the working temperature higher than boiling nitrogen this system is already nearer to a technological application, even if the saturation of this magnetic material is not very big.
For electric-capacitive systems the situation seems to be much better. The Yusa-Sakaki FET

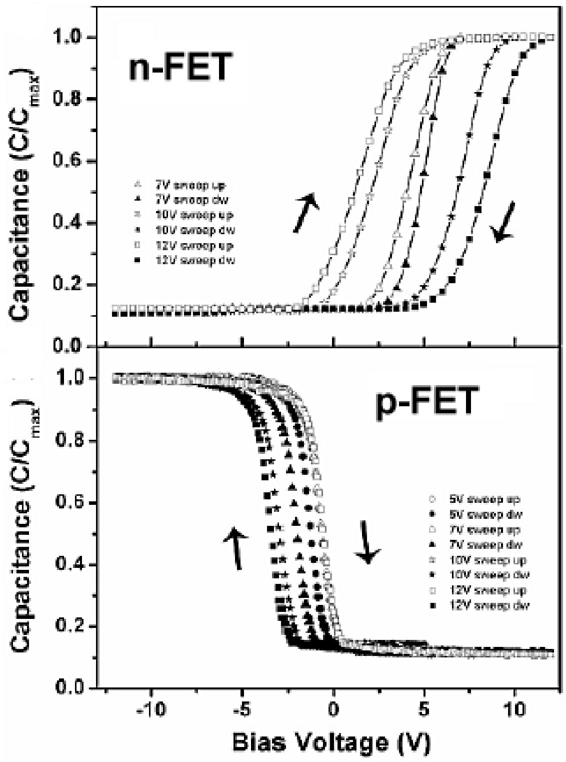

Fig.2: inverted gain hysteresis of the gate capacitance of an MFIS-Fet from [9]-[11]
on Integration of these diagram one obtains Q-V diagram s with an inverted overunity-gain hysteresis

mentioned by Wiepütz [1] seems to be a well understood solid experimental system, the drawbacks of this system are mainly economical because the cycle is proceeded very slow. More cheaper to produce and near to current Si-technology is a MFIS - FET described by Ko, Pak et al. [9-11]. This research group measures an inverted hysteresis of the capacitance-voltage diagram of the gate capacitance of this special FET, cf. fig.2. The diagram can be transformed into a charge-voltage diagram by integration and it shows the gain working area of an overunity-cycle. We will show here that this FET can be used for the synthesis of a very simple overunity oscillator circuit.

how to synthesize a simple overunity oscillator

The normal oscillator circuit with damping is a well known electronic circuit, cf. Fig.3 As far as all elements are linear the behaviour is exactly analytically predictable, cf. first two columns (linear case) of tab.1. There exist three cases how this sort of oscillator can behave:

For high damping it simply relaxes to zero, for low damping it relaxes in a damped oscillation. For no damping it oscillates permanently. If started by the initial conditions the circuit

Table 1: Comparison linear to nonlinear oscillator

linear case		non-linear case	
$\gamma = R/L = 0$		$\gamma = R/L < c_1$	 permanent oscillation
$\gamma = \left(\frac{R}{2L}\right)^2 < \frac{1}{LC}$		$c_1 < \gamma = R/L < c_2$	damped oscillation
$\gamma = \left(\frac{R}{2L}\right)^2 > \frac{1}{LC}$		$c_2 < \gamma = R/L$	relaxation

dissipates the energy stored up by the initial condition. For the linear oscillator capacity and inductivity no energy exchanging working diagram exist. However, if these elements become nonlinear and have an inverted energy hysteresis an electric energy influx must be present during an oscillation. This may prevent the relaxation to equilibrium at low resistance, cf. the second two columns of tab.1 and an oscillation appears. The situation can be simulated by a test circuit consisting of a nonlinear capacitance with an inverted hysteresis, a normal linear

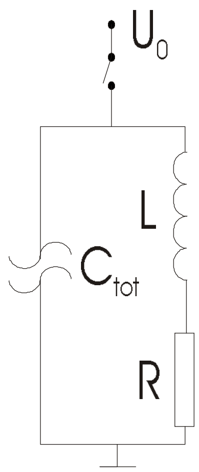

Fig 3: standard oscillating circuit but with a nonlinear capacitance

inductivity and a normal resistor. We simulated a test circuit as shown in fig. 3. The detailed model and its programming is described in the appendix. Fig. 4 shows the result of the calculation. The model shows qualitatively that a nonlinear oscillation develops. After an initial stating phase this nonlinear oscillator is vibrating continuously without any electrical forcing from outside. The overunity-effect may be present as well for a damped non-linear oscillating system but this cannot be proved by our calculation.

It is clear that - if this result can be confirmed experimentally - the energy may be transferred from the capacitance instead to the resistor as well to other energy converting systems, as for instance to an ac-dc-converter or an ac-ac converter.

We showed by an example that oscillating circuits can be driven if an electronic elements of the oscillating circuit shows inverted hysteresis. This idea may be transferred also analogously to spatially oscillating magneto-mechanic systems. Then one replaces inductivity L $\mapsto$ mass m, current I $\mapsto$ space coordinate x, inverted hysteresis capacitance C $\mapsto$ non-conservative coupling magnetisation . Such a system may be realized in the Steorn patent claim [12][13].

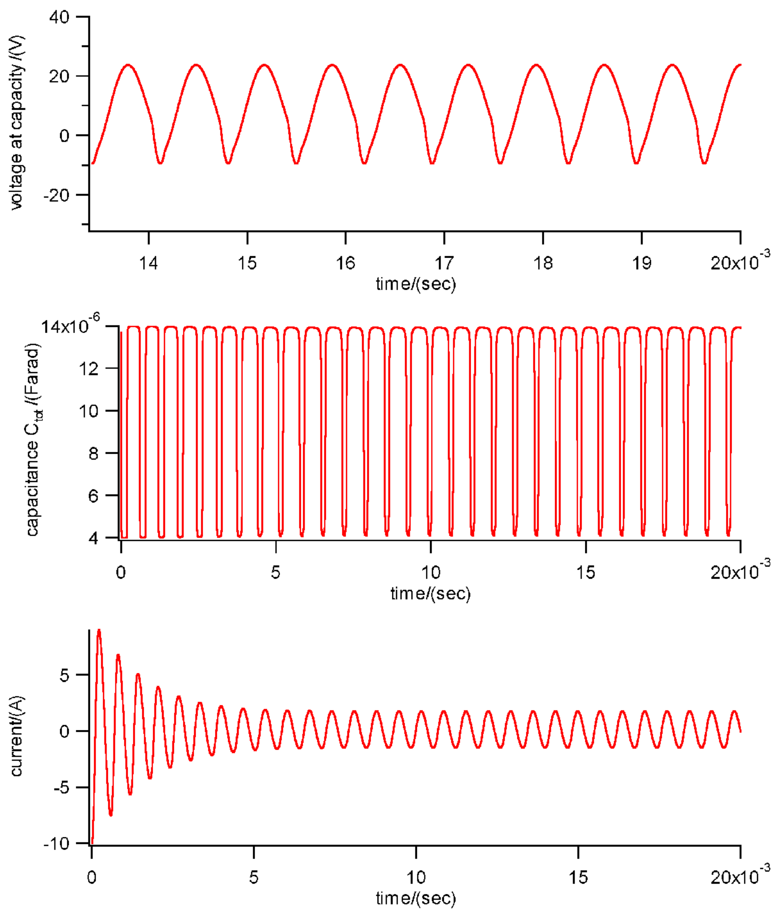

Fig.4: parametric overunity oscillation of a simple oscillation circuit with an inverted hysteresis capacitance; data of calculation: U_shift-$\Delta U_C^{sat}/2$=±5; $Norm$=1/2; C_1=10^{-5}; C_0=4*10^{-6}; L=10^{-3}, R=1, γ=1; cf. appendix;

Appendix:

The numerical model is based on the circuit shown in fig. 3 with a nonlinear capacity from fig.5. In order to be able to set a working point of the non-linear (differential) gate capacity C_1 of the FET we drive it over a much bigger coupling capacity C_{buf}. The working point of $C_{tot}^{-1} = C^{-1} + C_{buf}^{-1}$ (with $C:=C_0 + C_1$) can be set by loading the total capacitance C_{tot} with an offset charge Q using the external voltage source U_{ext}. The galvanic separating capacity C_{buf} is chosen to be $C_{buf} >> C:=C_0 + C_1$. Then, it holds about $C_{tot}^{-1} = C^{-1} + C_{buf}^{-1} \approx C^{-1}$ and the capacitive resistors C_{buf} can be neglected in the calculation of the circuit. The additional capacity C_0 is smaller than the maximum of C_1, it represents the offset of capacity in fig.5 and it may be enlarged artificially by a capacitance added in parallel eventually in order to prevent that the FET-gate capacity is killed by a sparking of the coil. The capacitances C_0, C_{buf}, the resistance R and the inductivity L are regarded to be linear.

The voltage rising or descending branch of the hysteresis curve of the capacity C_1 can be approximated each by the function

$$C_1 = C_1^0 \left(\frac{\pi/2 + \arctan((U_c - U_{shift})/Norm)}{\pi} \right)^{\gamma}$$

where U_c is the voltage at the gate capacitance, U_{shift}, $Norm$ and γ are fit parameters to the real electronic element. They can be fit each for the up and down branch of the hysteresis curve.

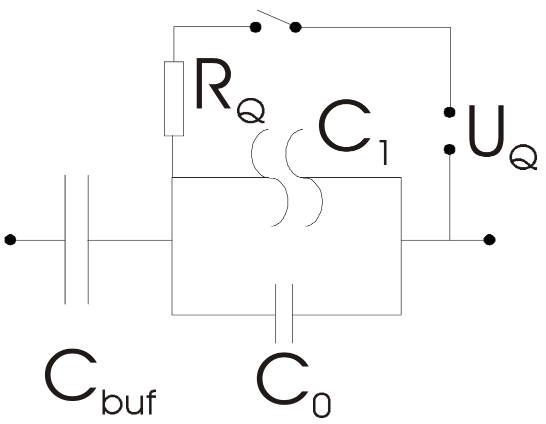

Fig.5 the replacement circuit for C_{tot} in fig.3

The gate capacitance can be precharged by U_Q

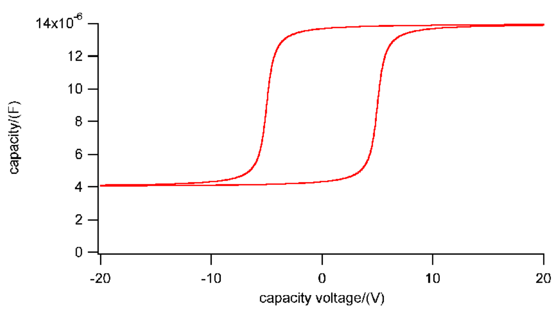

Fig.6: capacity C_{tot} vs. capacitance voltage U_C diagram for the replacement circuit of the capacitance C_{tot} in fig.3 and fig 5.

If the oscillation switches from rising to descending voltage at the capacitance, the fit parameters are switched as well. Of course we have assumed here that the oscillation voltage drives the FET fully into saturation and the discontinuity of C_1 remains negligible at the switching points. In deed, the programming of the problem shows that -dependent from the parameter chosen - this can be the case because then no relevant discontinuity is visible in all solved curves. So the oscillation amplitude is swinging fully into the saturation states of the gate capacity C_1.

In order to realize this continuity of the total FET capacity C_{tot} or also in order to ease the programming C_1 is precharged so that the amplitude U_{tot}^0 of the non-linear oscillation voltage $U_{tot}=U_{tot}^0.(a_1 .sin(w.t)+a_2.sin(2wt)+....)$ at the capacity is about the half of the voltage difference ΔU_c^{sat} between the points where the gate capacity C_1 starts to saturate. Under this condition C_{tot} becomes

$$C_{tot}=C_0+C_1^0\left(\frac{\pi/2+\arctan([U_{tot}-(U_{shift}+\Delta U_c^{sat}/2)]/Norm)}{\pi}\right)^{\gamma}$$

Typical parameters chosen in the calculation are $(U\_shift+\Delta U_C^{sat}/2)=\pm 5$; $Norm=1/2$; $C_1=10^{-5}$; $C_0=4*10^{-6}$; $L=10^{-3}$, $R=1$, $\gamma=1$. If the voltage at the capacitance rises $(U\_shift+\Delta U_C^{sat}/2)=\pm 5$ is set positive, otherwise it is negative. All other parameters of the model remain constant.

The problem can be solved surely by the most commercial electronic circuit design programs like PSPICE . We do it here explicitely. The differential equation of the circuit is

$$L\ddot{I}+R\dot{I}+I/C_{tot}(t)=\dot{U}_0$$

with U_0 from fig.3. In order to solve the problem this differential equation of second order is decomposed into a system of two differential equations of first order

$$\dot{I}=-\frac{R}{L}I+z+\frac{U_0}{L}$$
$$\dot{z}=-\frac{1}{LC_{tot}}I$$

The whole problem can be solved by discretization using the Euler method. Typical starting conditions are $U_0=10$, $I=U_0\ /R$ and $\dot{I}=0$. A typical result has been shown already in fig. 4

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