

The Mechanical Translation of Mortal Oscillatory Rate

A laboratory monograph on converting the beam-ray studies into a cutaneous haptic instrument

Notes toward a wearable oscillator

Royal Raymond Rife spent the better part of his working life proving one stubborn fact: a living organism is not only chemistry. It is a vibrating structure. Under the Universal Microscope he watched microbes hold their form until a precise rate was applied, after which the organism lost cohesion. He called that rate the Mortal Oscillatory Rate — the MOR. The original instrument delivered it electromagnetically, as a modulated radio carrier through a noble-gas plasma tube. That apparatus was large, delicate, and bound to a bench.

The principle does not require a laboratory rack. Resonance is resonance. What is being specified here is the same work translated into mechanical oscillation coupled directly into living tissue through the skin. A haptic wearable. Compact enough to wear. Precise enough to hold frequency.

This is not a toy vibrator with a printed list of numbers. It is a frequency-accurate mechanical radiator, designed so the listed rates can be delivered as displacement of tissue rather than as a free-space electromagnetic field.

1. The conversion problem

The original beam ray used two nested rates:

- a high-frequency carrier that ionized the gas and radiated
- a lower modulating rate - the MOR of the organism under study

Modern contact instruments already abandoned the plasma tube and applied audio-range square or sine waves through electrodes. That is one translation. Haptics is another: instead of current or RF, we apply a controlled mechanical waveform whose fundamental, harmonics, and envelope are locked to the same numerical rates.

The skin is not an antenna. It is a viscoelastic waveguide. Pacinian corpuscles respond strongly from roughly $(100)-(400\,\mathrm{Hz})$ and remain useful toward $(800\,\mathrm{Hz})$. Meissner corpuscles cover the flutter band near $(5)-(50\,\mathrm{Hz})$. That is the window in which a wearable can actually couple energy into the nervous and connective structure rather than merely making a buzzing sound.

Therefore the instrument uses three mapping modes:

1. **Direct drive** - the actuator oscillates at the listed MOR when that MOR lies inside the tactile band $((20)-(500\,\mathrm{Hz}))$, extendable to $(\sim 1\,\mathrm{kHz})$ with piezo or voice-coil).
2. **Subharmonic lock** - for listed rates above the actuator's clean bandwidth (e.g. $(2128\,\mathrm{Hz})$, $(2720\,\mathrm{Hz})$), drive at (f/n) where $(n = 2,3,4\ldots)$ and keep phase-coherent harmonics in the displacement spectrum.
3. **Carrier-in-the-sweet-spot** - hold a mechanical carrier near $(200)-(250\,\mathrm{Hz})$ (peak Pacinian sensitivity) and amplitude-modulate it at the listed MOR or at a low-frequency program rate. This is the mechanical analogue of my original modulated carrier.

The last mode is the closest philosophical descendant of the beam ray: a high-efficiency carrier, quenched or modulated at the working rate.

Common working numbers from the early lists and the later compiled tables include:

Organism / entry (historical lists) Frequently cited rates (Hz)

Staphylococcus	(727), (728), (784)
Streptococcus	(880)
Escherichia coli	(800)-(802)
Candida	(465), (728), (880)
BX / carcinoma entries	(2127)-(2128)
Tuberculosis entries	(800), (1550), (2128)
Low-band systemic	(20), (40), (72), (95), (120)

Treat these as *research dial settings*, not as a pharmacist's labels. The instrument stores them as floating-point setpoints with $(0.01\,\mathrm{Hz})$ resolution.

2. Why haptics instead of electrodes or plasma

Plasma radiates. Electrodes inject current. Both have their place. A haptic wearable has different virtues:

- No conductive gel, no RF licensing, no tube life.
- Energy is deposited as shear and compression in dermis, fascia, and periosteum.
- The wearer can walk, sleep, or work.
- Spatial arrays let different body regions run different rates simultaneously - something a single plasma tube never did cleanly.
- Amplitude is independently set from frequency if the right actuator is chosen.

The cost is bandwidth. A cheap phone motor cannot sing $(2128\,\mathrm{Hz})$ as a clean sinusoid. That is an engineering constraint, not a philosophical one. We design around it.

3. Actuator physics - the heart of the instrument

Three classes of transducer are usable. We specify a hybrid array.

3.1 Linear resonant actuators (LRA)

An LRA is a voice coil, a sprung mass, and a magnet. Drive it at its mechanical resonance and it is efficient. Off resonance, amplitude collapses.

Typical coin or bar LRAs lock near $(150)\text{--}(235)\,\mathrm{Hz}$. That is almost exactly the Pacinian peak. They are therefore the *carrier engines* of the wearable: always available for mode 3, and useful in mode 1 for any MOR that happens to fall on their resonance after a small mechanical trim.

Exploded construction of a Y-axis LRA - sprung mass, coil, and magnet in a coin envelope:

Z-axis (normal-to-skin) LRAs couple better into tissue than spinning ERMs. Use those.

3.2 Wideband voice-coil / linear magnetic rams

These are the true MOR engines. Unlike an LRA, they are not prisoners of one spring frequency. A properly suspended voice coil (Haptuator-class, Titan LMR-class, or a custom moving-magnet puck) can be driven from a few hertz to several hundred hertz with independent amplitude control.

This is what lets $(40)\,\mathrm{Hz}$, $(120)\,\mathrm{Hz}$, $(465)\,\mathrm{Hz}$, and $(727)\,\mathrm{Hz}$ exist on the same garment without swapping hardware.

3.3 Piezo benders and stacks

Piezoelectric actuators give the high end: fast edges, bandwidth toward $(1)\,\mathrm{kHz}$, thin profile. They want higher drive voltage $((12)\text{--}(120)\,\mathrm{V})$ depending on the element) and a capacitive driver. I place them over bony landmarks and on the wrist where a sharp, high-frequency tick is wanted and mass is limited.

3.4 What we will not use as the primary oscillator

Eccentric rotating mass (ERM) motors. Frequency and amplitude are locked together. Rise time is sluggish. They cannot hold a listed rate. They may serve as a cheap “presence” rumble under a vest panel, nothing more.

Actuator comparison for this instrument:

	LRA	Voice coil / LMR	Piezo	ERM
Independent (f) and amplitude	No (narrow Q)	Yes	Yes	No
Useful band	~ 150 - 235 Hz	~ 10 - 500 Hz	DC - 1 kHz	50 - 250 Hz, coupled
Rise / stop	5 - 20 ms	2 - 10 ms	< 1 ms	50 - 250 ms
Role in the garment	Carrier / Pacinian lock	Primary MOR channel	High-rate / edge	Not primary

4. Coupling into the body

A frequency that exists only in the actuator is wasted. The mechanical chain is:

actuator $\rightarrow$ stiff puck or plate $\rightarrow$ skin preload $\rightarrow$ dermis $\rightarrow$ Pacinian / fascial sheet $\rightarrow$ bone as a sounding board

Design rules:

- Preload (1) - 10 kPa. Too loose and you get rattle. Too tight and you shift resonance and bruise.
- Contact diameter (12) - 25 mm for voice coils; smaller for piezo.
- Prefer normal (Z) excitation into the skin.
- Place actuators where tissue is thin over bone or where Pacinian density and referral are useful: volar wrist, sternum, paraspinal, anterior tibia, plantar fascia, occiput band.
- Do not expect fingertip spatial resolution from a torso actuator. The vest is for systemic coupling; the wrist and ankle cuffs are for local coupling.

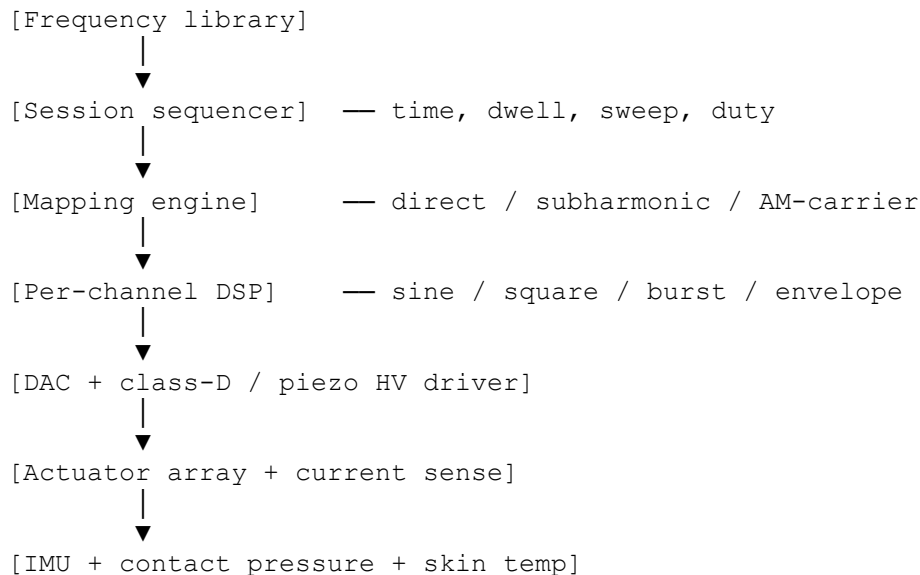
A practical wearable topology uses several contact regions rather than one motor in a watch:

We specify four garments that share one controller:

1. **Wrist cuff** - 2–4 wideband actuators, highest perceptual acuity.
2. **Ankle / sole inserts** - low-band and mid-band; good bone conduction.
3. **Thoracic sash or vest panel** - 6–12 actuators over sternum and paraspinals.
4. **Cervical / occipital band** - light piezo + one voice coil.

The controller may run one garment or all of them as a synchronized array.

5. System architecture



5.1 Oscillator

A microcontroller with a hardware timer and a DDS (direct digital synthesis) core, or an FPGA if you want many independent channels with zero jitter. Requirements:

- Frequency resolution $\leq 0.01 \text{ Hz}$ from 0.1 Hz to 5 kHz
- Phase-continuous frequency changes (no clicks when the sequencer steps)
- Per-channel amplitude in 0.5 dB steps
- Simultaneous channels: minimum 8, preferred 16

Waveforms we actually use:

- **Sine** - cleanest mechanical tone; first choice for MOR lock.
- **Square / pulse** - rich odd harmonics; useful when a listed rate is above the actuator band, because the harmonics still tickle Pacinian receptors.
- **Burst / gated carrier** - 200 Hz carrier gated at $1\text{--}20 \text{ Hz}$ or at a listed low rate. Closest to the old quench.
- **Slow sweep** - $\pm 0.5\%$ around a setpoint. Organisms in tissue are not laboratory oscillators; a narrow sweep covers detuning from temperature and preload.

5.2 Drive electronics

- Voice coil / LRA: current-mode class-D, $5\text{--}15 \text{ V}$ rail, per-channel current sense so we can detect lift-off and overheating.
- Piezo: CapDrive or similar high-voltage, low-energy driver. Piezo is a capacitor; do not drive it like a motor.

- PWM carrier, if used, well above $(20\,\mathrm{kHz})$ and analog-filtered so the actuator never sings the PWM.

5.3 Power

A $(3.7\,\mathrm{V})$ (2000) $-(4000\,\mathrm{mAh})$ pack for a cuff. A vest wants more. Average draw depends on how many channels are live:

- One LRA at modest amplitude: $(\sim 0.2\,\mathrm{W})$
- One voice coil working hard: $(0.5) - (2\,\mathrm{W})$
- Full vest, eight channels: budget $(8) - (15\,\mathrm{W})$ peak, far less average if the sequencer uses dwell and rest

Thermal limit on skin-contact metal: keep case temperature under $(41^\circ\mathrm{C})$. Fold current if an NTC on the puck climbs.

5.4 Sensing (this is not optional)

Rife ruined enough experiments by not measuring the output. Each channel needs:

- Drive current
- Optional accelerometer on the puck (actual displacement, not commanded voltage)
- Strap tension or FSR preload
- Optional optical pulse / skin temperature for logging, not for “diagnosis”

Closed-loop amplitude: regulate measured acceleration, not voltage. Loading by flesh changes everything.

6. Mapping engine - how a listed rate becomes motion

Let (f_{MOR}) be the library frequency and (f_{act}) the instantaneous actuator frequency.

Mode A — Direct

$$[f_{\mathrm{act}} = f_{\mathrm{MOR}} \quad \text{when} \quad 20 \leq f_{\mathrm{MOR}} \leq f_{\mathrm{max}}]$$

(f_{max}) is about $(400\,\mathrm{Hz})$ for a loaded voice coil, $(800) - (1000\,\mathrm{Hz})$ for piezo.

Mode B - Integer subharmonic

$$f_{\mathrm{act}} = \frac{f_{\mathrm{MOR}}}{n}, \quad n = \min\{n \in \mathbb{N} : f_{\mathrm{act}} \in [f_{\min}, f_{\max}]\}$$

Example: $(2128 / 8 = 266, \mathrm{Hz})$ - still in the Pacinian well, and the 8th harmonic theoretically reconstructs the parent rate in the nonlinear tissue path. We do not pretend tissue is a perfect harmonic lock. We do insist the arithmetic is exact.

Mode C — Amplitude-modulated tactile carrier

$$x(t) = A(t) \sin(2\pi f_c t), \quad A(t) = A_0 \bigl(1 + m \sin(2\pi f_{\mathrm{MOR}} t)\bigr)$$

with $(f_c \approx 220, \mathrm{Hz})$ (trim per actuator resonance and preload) and modulation index (m) from (0.3) to (0.9).

This is the wearable beam ray.

Mode D - Program stack

A session is a list:

```
{rate, mode, waveform, amplitude, dwell_s, rest_s, channels[]}
```

Typical dwell on one rate: (180) - (360, s). Early clinical notes around the beam ray used repeated short exposures, not one all-day blast. The sequencer should honor rest. Tissue adapts; Pacinian afferents are rapidly adapting by nature.

7. Mechanical design of the garment

- Inner face: thin, high-friction medical elastomer so the puck does not walk.
- Puck: anodized aluminum or glass-filled nylon, 1–2 mm thick, edges radiused.
- Wiring: FPC or silicone-jacketed pair; no stiff loom across a joint.
- Enclosure IP54. Sweat is the enemy of coils.
- Fasteners: hook-and-loop plus one elastic segment so preload is repeatable.
- Mass budget: wrist cuff under (80, g) including battery if the pack is remote; vest actuators distributed so no single panel feels like a brick.

A voice-coil thimble or local puck is the right mental model for a single site - moving mass, coil, membrane, soft body:

Scale that idea up: many pucks, one clock.

8. Firmware and the frequency library

The library is a versioned JSON or SQLite table:

```
id, label, rates[], default_mode, default_waveform,  
default_dwell, notes, source
```

`source` matters. Early laboratory rates, later compiled lists, and harmonic derivatives are not the same object. Keep them tagged. We would rather a short honest table than a ten-thousand-line dump with no provenance.

The UI (phone over BLE, or a three-button module on the cuff) exposes:

- Select program
- Start / pause / abort
- Amplitude 0-100% with a hardware cap
- Live display of actual (f) and measured g-force
- Session log to file

No automatic “diagnosis.” The instrument does not guess what lives in a man. It runs the rates the operator loaded.

Safety interlocks in firmware:

- Maximum continuous on-time per channel (e.g. $(20\,\mathrm{min})$) then mandatory rest
- Maximum acceleration (I start at $(2\,\mathrm{g})$ peak at the puck and climb only with logging)
- Immediate cut on strap-off
- Immediate cut if case temperature or coil current is abnormal
- No DC offset on voice coils (avoid thermal and magnetic bias)

9. Calibration bench

Before a garment leaves the bench:

1. Sweep $(10\,\mathrm{Hz})$ unloaded. Record resonance and Q.
2. Sweep on a calibrated mass and on a skin analog (silicone over a bone-like core).
3. Measure THD at the working amplitudes. Square waves will be dirty; that is intended. Sines should be clean.
4. Verify frequency against a reference counter, not against the firmware’s wish.
5. Confirm that commanded $(727.00\,\mathrm{Hz})$ is $(727.00\,\mathrm{Hz})$ at the coil, not (719) because someone used a rounded timer.

If you cannot measure the output, you do not have an instrument. You have a belief with a battery.

10. A reference session architecture

Example - a three-block wrist protocol using only rates that sit honestly in the tactile band, plus one high-list entry mapped by Mode B/C.

Block	Setpoint	Mode	Wave	Dwell	Notes
1	$\backslash(40.0, \mathrm{Hz}) \backslash$	Direct	Sine	$\backslash(4, \mathrm{min}) \backslash$	Low-band coupling
2	$\backslash(120.0, \mathrm{Hz}) \backslash$	Direct	Sine	$\backslash(4, \mathrm{min}) \backslash$	Flutter / mid
3	$\backslash(220.0, \mathrm{Hz}) \backslash$	Direct	Sine	$\backslash(3, \mathrm{min}) \backslash$	Pacinian lock / carrier check
4	$\backslash(727.0, \mathrm{Hz}) \backslash$	Direct if piezo; else (242.3) ($\backslash(n=3) \backslash$) or AM at (220)	Square or AM	$\backslash(5, \mathrm{min}) \backslash$	Classic list entry
5	$\backslash(880.0, \mathrm{Hz}) \backslash$	Piezo direct or (220) AM	Square / AM	$\backslash(5, \mathrm{min}) \backslash$	Classic list entry
Rest	—	—	—	$\backslash(2, \mathrm{min}) \backslash$	Between blocks as needed

That is a *machine program*, not a prescription.

11. What this instrument is, and what it is not

It is a wearable mechanical oscillator with a frequency library inherited from the MOR work and from the later compiled tables that grew up around that work.

It is not a plasma beam ray. It does not reproduce the original RF carrier in free space. It does not replace a physician, a culture plate, or a microscope. Rife said in 1931 that electrical “vibration” fakers were already loose in the marketplace. The warning still holds. If the frequency is not measured, the amplitude is not controlled, and the dwell is a marketing timer, the device is a toy.

Build it so that every number on the screen exists as motion in tissue. Log it. Repeat it. That is how the microscope work was done - look, apply a rate, look again.

The beam ray was a way to put a number into an organism from a distance. The haptic wearable is a way to put the same number into an organism through the one instrument every mammal already carries: the ski.