Topcat Metrology Ltd

"Looking behind the measurement"

www.mousemet.com www.topcatmetrology.com

Another EvF system…Why?

Mousemet and **RatMet** were conceived after discussions with researchers who stated that von Frey filaments, while giving a well trusted answer, were time-consuming and awkward for the measurement of mechanical thresholds in rodents. They also commented that the existing electronic von Frey (EvF) systems were insufficiently sensitive for mice and marginal in their force range for rats. We spent time watching people testing with both methods, participated in several studies ourselves and then drew some conclusions:

Filaments:

Von Frey filaments work well, within their limitations, but:
1) They require a number of readings to establish one threshold.
2) The data require post processing (the up-down or the % response method).
3) The threshold is discrete, not on a continuous scale, and the data therefore should be not be treated parametrically for statistical purposes.
4) Each filament has a different diameter and the area of contact changes when the filament buckles.
5) They are fragile and give a lower threshold force if initially bent (from previous rough treatment).

Electronic von Frey:

In our opinion, the existing EvF systems on the market are not optimised for rodents:
1) They are generally "stiff" transducers, making no allowance for the inevitable slight hand tremor of the operator (in all three planes).
2) Their force ranges are excessive; thresholds on a mouse's foot are usually in the range of 0.1-5 gf but the devices available have force ranges of up to 90 or even 500 gf.
3) They require too much of the operator; following rate lights or a ramp on a screen is not realistic for a 5 second test where it is vital to watch the subject.

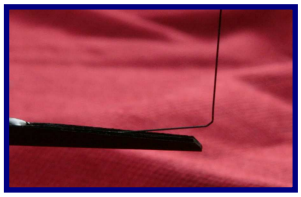
How?

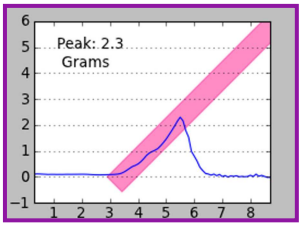
The transducer

We designed and built a "soft" transducer that absorbs the effect of the operator's hand tremor in the vertical direction. MouseMet has a force range of 0.1 to 7 gf and RatMet from 1-80gf. They are rotary transducers; to apply the force, the probe tip is brought into contact with the foot and the body of the transducer rotated by the black handles. This is a natural and easy action with the elbows resting on the table (and the rodent run at the correct height). At threshold, the red button is pressed and the graph of force, with the peak measurement, is displayed immediately on the computer.

The probe

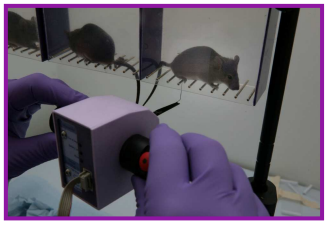
We built a probe tip which is flexible sideways (like a filament before it buckles). This prevents hand tremor from causing the probe tip to scratch across the foot surface at touch-on. Then, for MouseMet, we added a bend which softens the action of the transducer further over the first 0.5 g of force application. These two features considerably reduce the number of touch-on responses.





The software

We wrote software that compares the force ramp immediately after the test with an overlaid indicator of force rise rate. Operators may therefore tune their technique for the next test. All results are stored in a database and may be exported to Excel.



Patents applied for

The MouseMet and RatMet transducers and the run system detailed on page 2 of this document are the subject of current patent applications in the UK, Europe and the USA.
The technical details of both systems are subject to change without notice.

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Where?

The Cages:

Studies require a lot of mice, often tested in multiples of four. Once put into the testing environment, they take time to explore and testing can only start when they have finished. Inefficient mouse handling therefore wastes a lot of time.

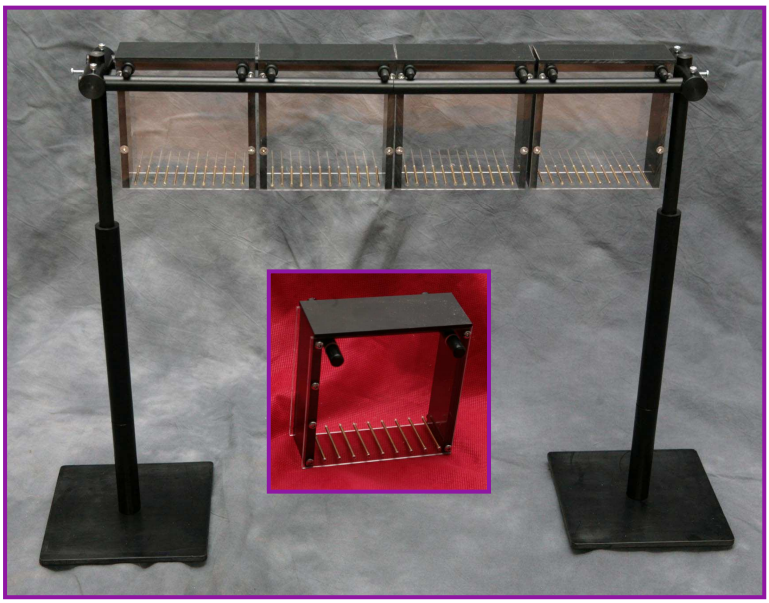
We noticed that the cage systems used are often inappropriate; filament testing is performed on the plantar surface of the hind paw, aiming at the flat area of the pad where the "thumb" joins. With the mouse in a cage that allows free movement in two planes and which has a grid of bars as a floor, this area is difficult to see and arkward to access with a probe or filament.

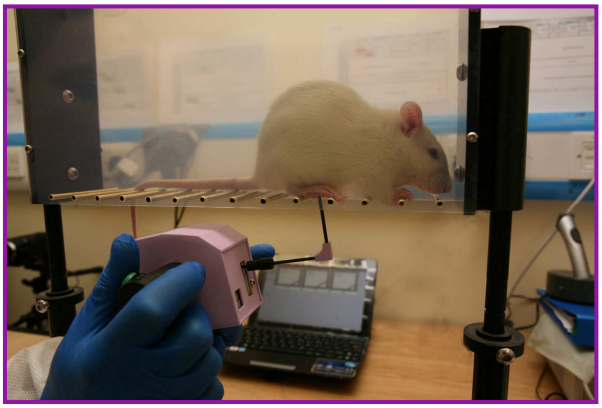
We also noted that the cage supports are often restrictive, not allowing the enclosure to be positioned at a suitable height for the measurement. When testing a lot of rodents, this can lead to operator fatigue and strain.

The MouseMet Testing Environment

We designed a long, narrow run that encourages the rodent to sit with its head pointing either left or right, on parallel bars running front to back in the run and spaced appropriately for the feet. This provides good access to the plantar surface and gives excellent visibility through the sides of the run. We supply four runs as standard with MouseMet but, if you buy four more, you can have the next set of mice acclimating while you test the first.

We built a height adjustable run support system for four mice. This means that you don't have to test sequentially; you can pick the mouse that is sitting still. For RatMet, the runs are supplied individually.





MouseMet Technical Specifications:

Force range: 0.1-7gf
Tip diameter: 0.3mm
Power supply: 2 off PP3 9V batteries (rechargeables and charger supplied)
Transducer weight: 170g

RatMet Technical Specifications:

Force range: 1-80gf
Tip diameter: 0.5mm
Power supply: 2 off PP3 9V batteries (rechargeables and charger supplied)
Transducer weight: 170g

Validation:

MouseMet and RatMet have been validated against von Frey filaments in five studies at three separate laboratories. In all cases, the MouseMet data were as tight or tighter than the filament data. In two studies MouseMet detected a significant difference between groups where filaments did not. The posters are available on the validation page of the website.

Research Publications:

Deuis JR et al (2013) http://dx.doi.org/10.1016/j.pain.2013.05.032
Deuis JR et al (2014) http://dx.doi.org/10.1093/neuonc/nou048

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