TECHNICAL PAPER

The new wave in speaker innovations

Transducer electrical equivalent circuit

Traditional model

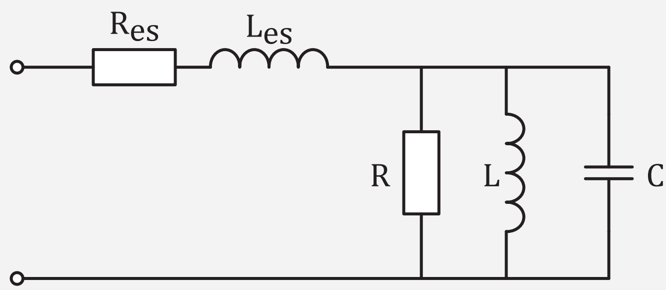

Fig. 1

$$L = (Bl)^2 \times C_{ms}$$

$$C = \frac{M_{ms} \times S_D^2}{(Bl)^2}$$

$$R = \frac{(Bl)^2}{R_{ms}}$$

M_{ms}	Driver moving mass incl. air
C_{ms}	Driver suspension compliance
R_{ms}	Driver mechanical loss
Bl	Driver force factor
S_D	Driver effective cone area
R_{es}	Voice coil DC resistance
L_{es}	Voice coil inductance

This page shows the differences between the traditional loudspeaker model (fig. 1 above) and the Wright empirical model (fig. 2 below).
The only difference between the two models is that the inductor Le of the traditional model has been replaced by the two components Rem and Lem in the Wright model. Rem is a resistor and Lem is an inductor but both components are frequency (f) dependent:

$$R_{em} = K_{rm} \times (2 \times \pi \times f)^{E_{rm}}$$

$$L_{em} = K_{xm} \times (2 \times \pi \times f)^{[E_{xm}-1]}$$

While the traditional model in many cases is very inaccurate at higher frequencies, the Wright model is much more accurate. There is not a big difference at low frequencies (bass tuning, for instance) but for crossover designs the traditional model is often not usable.

Wright empirical model

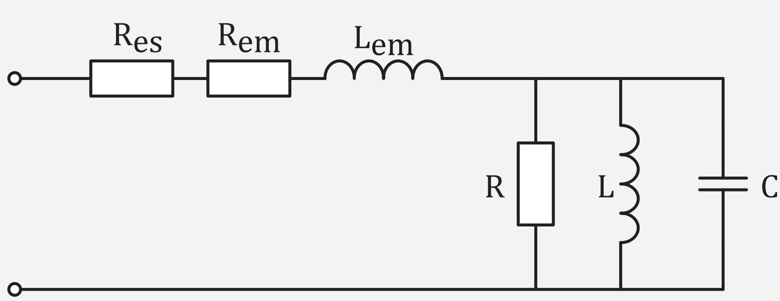

Fig. 2

$$L = (Bl)^2 \times C_{ms}$$

$$C = \frac{M_{ms} \times S_D^2}{(Bl)^2}$$

$$R = \frac{(Bl)^2}{R_{ms}}$$

M_{ms}	Driver moving mass incl. air
C_{ms}	Driver suspension compliance
R_{ms}	Driver mechanical loss
Bl	Driver force factor
S_D	Driver effective cone area
R_{es}	Voice coil DC resistance
R_{em} and L_{em}	Replace L_{es} from the traditional model

REFERENCES. J. R. Wright, "An empirical model for loudspeaker motor impedance", J. Audio Eng. Soc., Vol. 38, No. 10, 1990.