One formula for $r$ is:

$$r = \frac{\sum xy}{\sqrt{\sum x^2 \sum y^2}}$$

Dividing numerator and denominator by $N$:

$$r = \frac{\sum xy / N}{\sqrt{\sum x^2 / N \sum y^2 / N}}$$

Note that $x$ and $y$ are assumed to be in deviation-score form (means of 0).

Letting the two parallel forms of the test be $x_1$ and $x_2$

$$r = \frac{\sum x_1 x_2 / N}{\sqrt{\sum x_1^2 / N \sum x_2^2 / N}}$$

Separating $x_1$ and $x_2$ into true and error components, the numerator becomes:

$$\sum (t + e_1)(t + e_2) / N$$

Note that the two forms have the same true score (for a given observation) but different errors of measurement.

Expanding terms, the numerator becomes:

$$\sum t^2 + \sum te_1 + \sum te_2 + \sum e_1 e_2 / N$$

Since the true scores and the errors of measurement are uncorrelated and each has a mean of 0, the terms that include error vanish since the average cross-product is 0.

$$\sum t^2 / N$$

which is the variance of true scores:
The denominator is the square root of the product of the two test variances. The two variances are:

\[
\frac{\sum x_1^2}{N} \text{ and } \frac{\sum x_2^2}{N}
\]

The square root of the product of the variances is simply the variance. The variances of \(x_1\) and \(x_2\) are equal and are denoted by as:

\[
\sigma_{Test}^2
\]

\[
\sqrt{\sigma_{Test}^2 \sigma_{Test}^2} = \sigma_{Test}^2
\]

Therefore, the correlation between the two parallel forms is:

\[
\frac{\sigma_{True}^2}{\sigma_{Test}^2}
\]