Computation of weighted integrals on the real line with nearby singularities

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In this talk we will be mainly concerned with the approximate calculation of integrals on the whole real line like,

$$\int_{\mathbb{R}} f(x)\frac{\sigma(x)}{P(x)}dx \tag{1}$$

where $\sigma(x)$ is a weight function on $\mathbb{R}$ and $P(x)$ a monic polynomial with real coefficients whose zeros can not lie on $\mathbb{R}$, but they could be close enough to the real axis. Computation of (1) will be made by passing to the unit circle by means of the Cayley Transform so that it becomes an integral of the form,

$$\int_{-\pi}^{\pi} g(e^{i\theta})\omega(\theta)d\theta,$$

which will be approximated by a quadrature rule on the unit circle.

Here, the crucial point is the calculation of the trigonometric moments for $\omega(\theta)$ does not mean an extra computational effort. An application to the effective computation of the Fourier Transform will be presented and several illustrative numerical experiments carried out.