Abstract. In this talk, we study the Tavis-Cummings model from a system-theoretic perspective. A typical form of the Tavis-Cummings model is composed of an ensemble of non-interacting two-level systems (TLSs) that are collectively coupled to a common cavity resonator. The associated quantum linear passive system is proposed, whose canonical form reveals typical features of the Tavis-Cummings model, including $\sqrt{N}$- scaling, dark states, bright states, single-excitation superradiant and subradiant states. The passivity of this linear system is related to the vacuum Rabi mode splitting phenomenon in Tavis-Cummings systems. On the basis of the linear model, an analytic form is presented for the steady-state output state of the Tavis-Cummings model driven by a single-photon state. Master equations are used to study the excitation properties of the Tavis-Cummings model in the multi-excitation scenario. Finally, in terms of the transition matrix for a linear time-varying system, a computational framework is proposed for calculating the state of the Tavis-Cummings model, which is applicable to the multi-excitation case.