Engineering control volume analysis for entropy production systems

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Many scientists are unfamiliar with "control volume analysis", a standard technique used in all branches of engineering and many other fields for the analysis of flow systems of all kinds. The basic principles of control volume analysis are first enunciated, and are then applied to rates of change of conserved quantities (e.g. mass, momentum, energy, charge) within a control volume. This leads to an engineering / thermodynamic definition of "steady state", as distinct from thermodynamic "equilibrium". The techniques of control volume analysis are then applied to rates of change of the thermodynamic entropy $S$, which being a non-conserved quantity, gives rise to the so-called "entropy production" term. Some technical details of entropy production calculations, which are not evident for other conserved quantities, are examined. The learning objective of this tutorial is to provide a deeper theoretical understanding and higher technical rigour in the attendees' calculations of the entropy production for any type of flow system.