In Kessler and Cour-Palais, 1978 the authors described and forecasted what has come to be known as "kessler syndrome", where debris collides with itself in such a way that the overall debris level grows exponentially. A few methods have been used to model this behavior in the economics literature.

The first one I want to explain was developed by Adilov et al., 2018. They characterize kessler syndrome as the point in time at which an orbit is unusable as each satellite launched will be destroyed within a single time period. In my notation, this is that $l^i(\{s^j_t\}, D_t) = 1$. The benefit of this approach is that it is algebraically simple. It was used in this role to show that firms will stop launching before orbits are rendered physically useless. Unfortunately, it does not convey the original intent of "kessler syndrome", i.e. a runaway pollution effect, but instead corresponds to the end result of kessler syndrome.

The second common definition of "kessler syndrome" is due to **RaoRondina**. They define it in terms of a "kessler region", the set of satellite stocks and the debris level such that:

$$\kappa = \left\{ \{s^j_t\}, D_t : \lim_{k \to \infty} D_{t+k} \left(\{s^j_{t+k-1}\}, D_{t+k-1}, \{x^j\} \right) = \infty \right\} \tag{1}$$

0.1 My approach to kessler syndrome

I propose to analyze kessler syndrome in a slightly more restricted fashion than **RaoRondina**. I would define the ϵ-kessler region as:

$$\kappa = \left\{ \{s^j_t\}, D_t : \forall k \geq 0, D_{t+k+1} - D_{t+k} \geq \epsilon > 0 \right\} \tag{2}$$

It is easily shown that this criteria is sufficient to guarantee Rao and Rondina's criteria. It has three primary benefits:

- The kessler region can be numerically described within bounded state spaces.
- In a Computational General Equilibrium Model, as most models of any complexity will be, you cannot check for divergence numerically. The condition given is a basic guarantee of the divergent behavior that is required for Kessler Syndrome and acknowledges computational limitations.
- Finally, a slow divergence is no divergence in the grand scheme of things. It is possible to have a mathematically divergent function, but one that is so slow, there is no noticable degree of debris growth before Sol enters a red giant phase. In this specification, it is possible to choose ϵ such that the divergent behavior has an impact on a meaningful timescale.