OPT

IMPLEMENTATION AND ANALYSIS OF A DYNAMICAL COVID-19 MODEL

By

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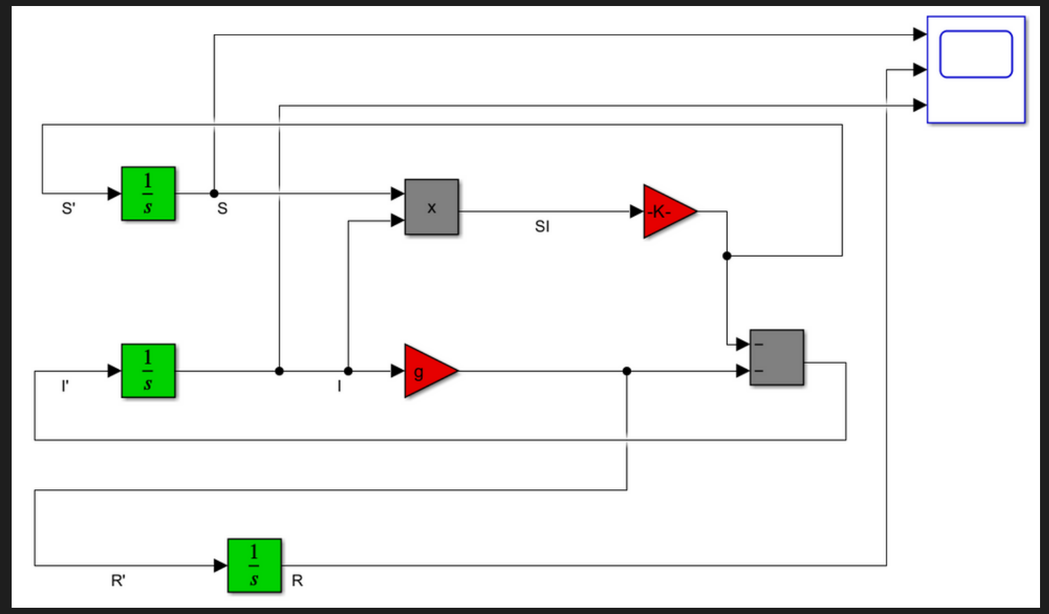
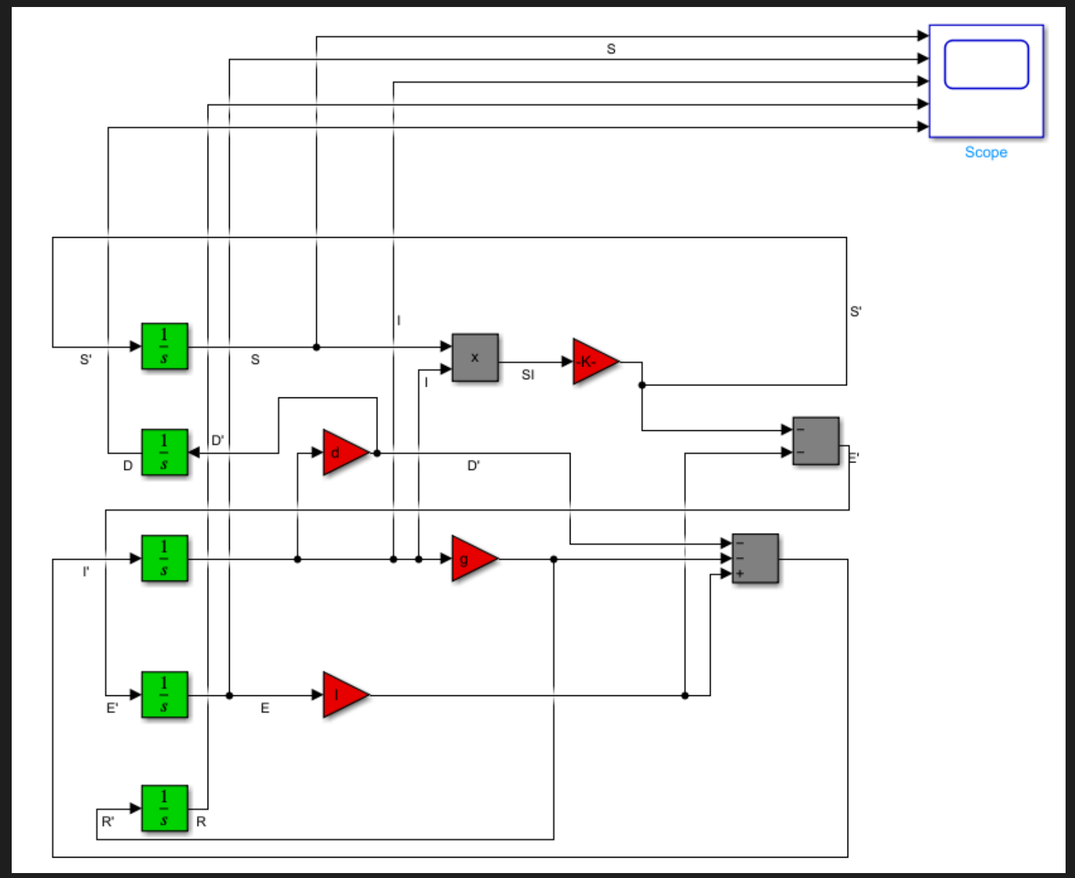
BASIC MODEL (SIR)

$$\frac{dS}{dt} = -\frac{\beta}{N}SI,$$
$$\frac{dI}{dt} = \frac{\beta}{N}SI - \gamma I,$$
$$\frac{dR}{dt} = \gamma I.$$



SEIRD MODEL

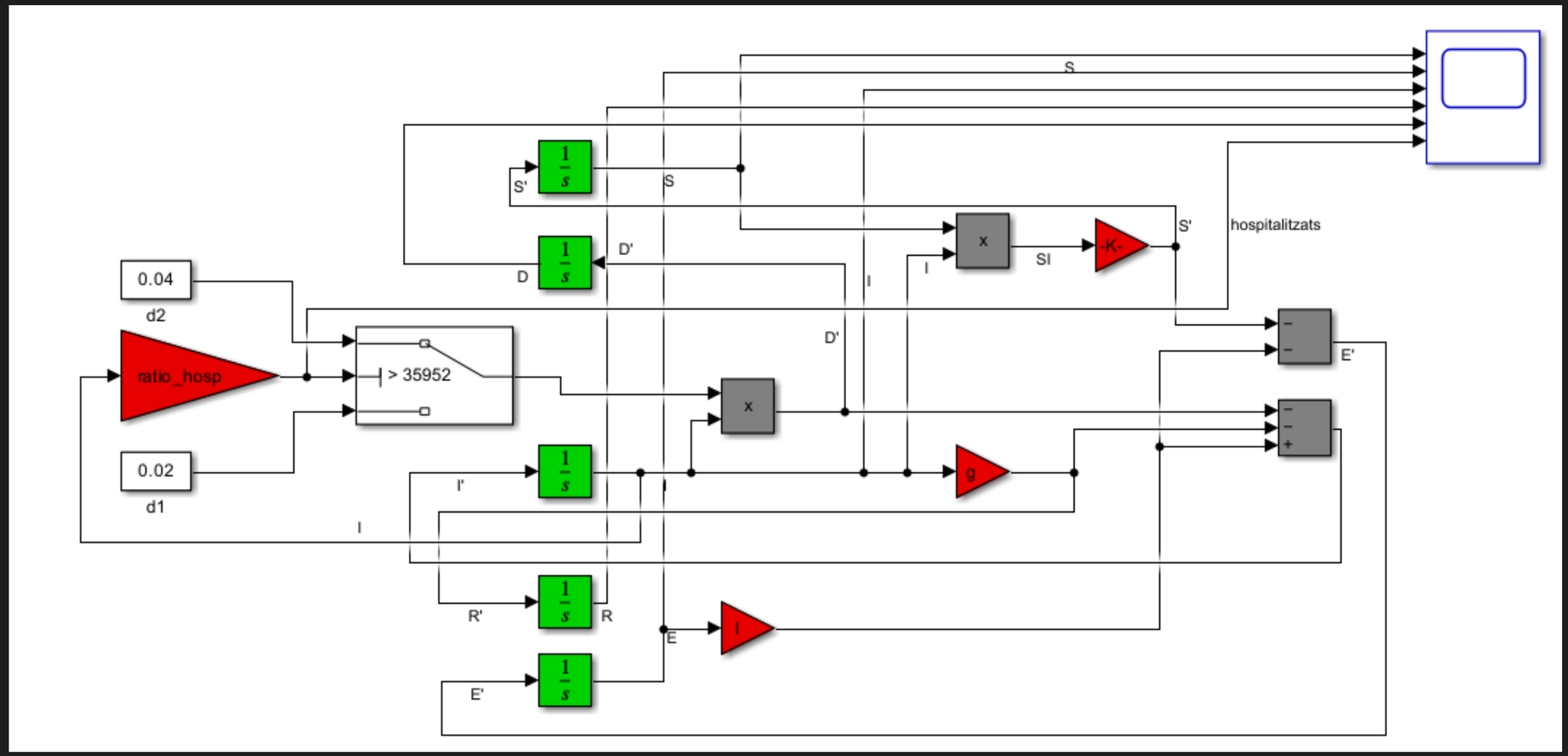
$$\frac{dS}{dt} = -\frac{\beta}{N}SI,$$
$$\frac{dE}{dt} = \frac{\beta}{N}SI - \lambda E,$$
$$\frac{dI}{dt} = \lambda E - \gamma I - \delta I,$$
$$\frac{dR}{dt} = \gamma I,$$
$$\frac{dD}{dt} = \delta I.$$



SEIRD + UCI MODEL

$$
\begin{aligned}
\frac{dS}{dt} &= -\frac{\beta}{N} SI, \\
\frac{dE}{dt} &= \frac{\beta}{N} SI - \lambda E, \\
\frac{dI}{dt} &= \lambda E - \gamma I - \delta' I, \\
\frac{dR}{dt} &= \gamma I, \\
\frac{dD}{dt} &= \delta' I. \\
\delta' &= \delta k.
\end{aligned}
$$

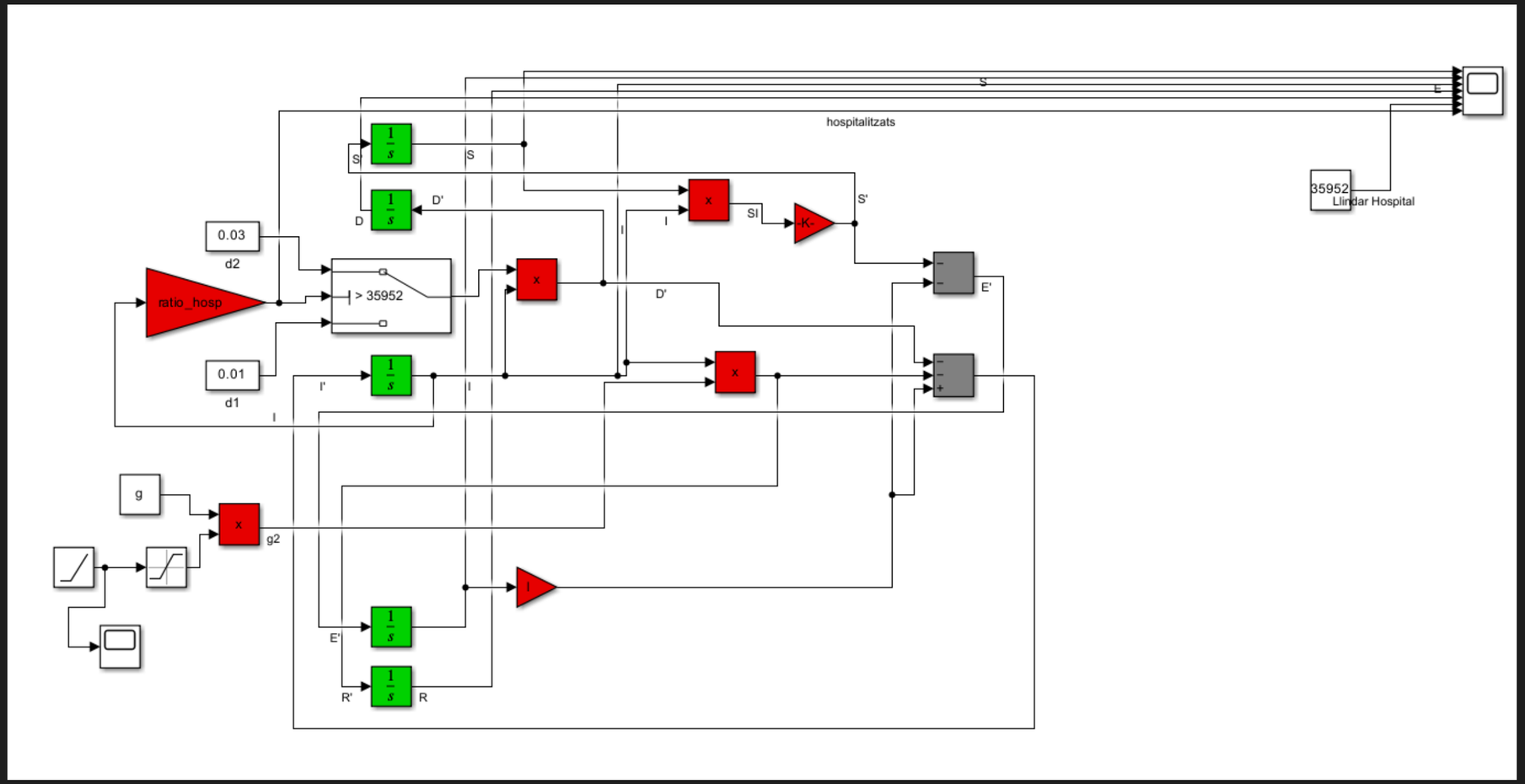
$$
k = \begin{cases} 1, & \text{if } 0.05I <= 35952 \\ 2, & \text{otherwise} \end{cases}
$$



UCI + VACCINATION MODEL

$$
\begin{aligned}
\frac{dS}{dt} &= -\frac{\beta}{N} SI, \\
\frac{dE}{dt} &= \frac{\beta}{N} SI - \lambda E, \\
\frac{dI}{dt} &= \lambda E - \gamma I - \delta' I, \\
\frac{dR}{dt} &= \gamma I, \\
\frac{dD}{dt} &= \delta' I. \\
\delta' &= \delta k.
\end{aligned}
$$

$$
k = \begin{cases} 1, & \text{if } 0.05I <= 35952 \\ 2, & \text{otherwise} \end{cases}
$$

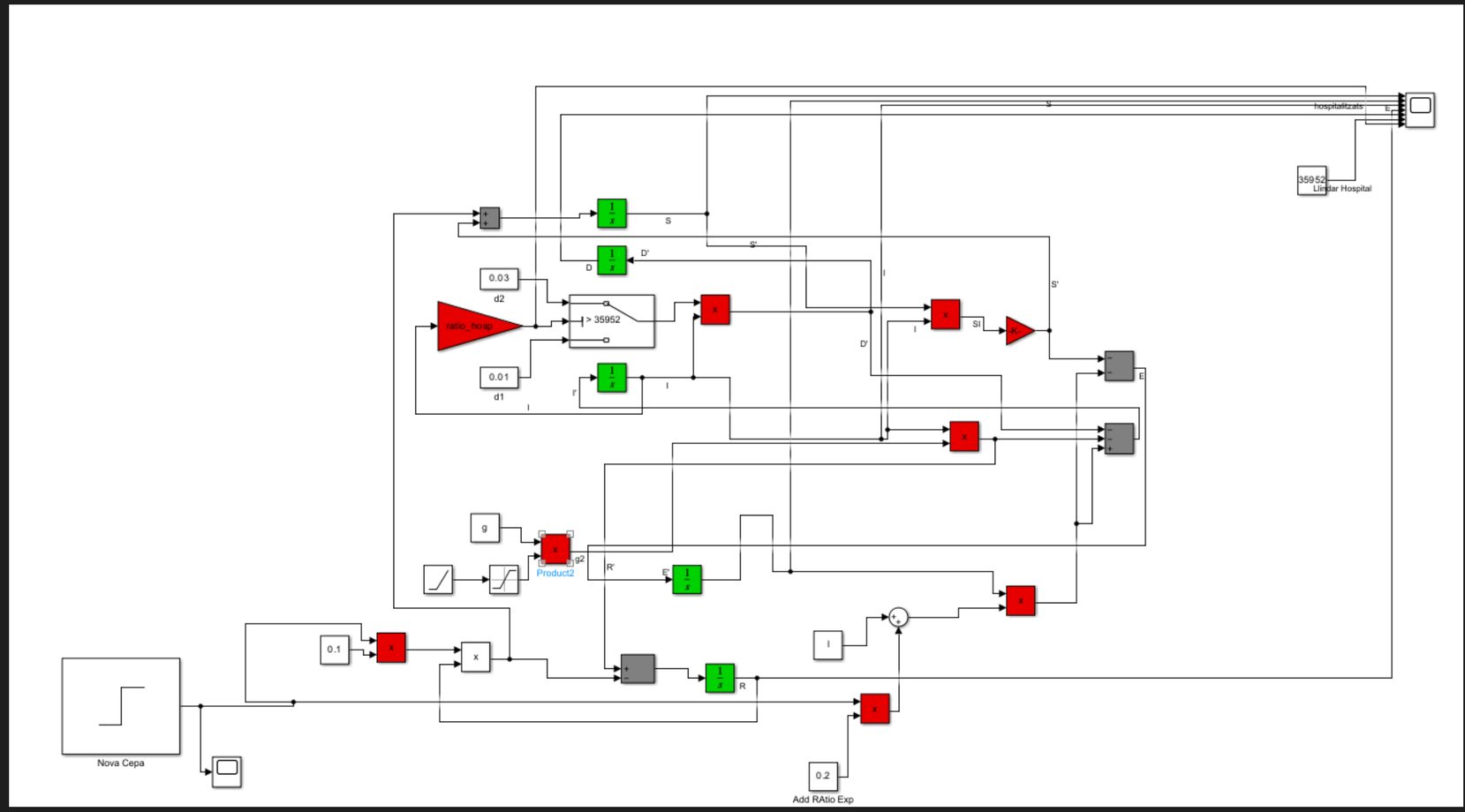


NEW VARIANT MODEL

$$
\begin{aligned}
\frac{dS}{dt} &= -\frac{\beta}{N} SI, \\
\frac{dE}{dt} &= \frac{\beta}{N} SI - \lambda E, \\
\frac{dI}{dt} &= \lambda E - \gamma' I - \delta' I, \\
\frac{dR}{dt} &= \gamma' I, \\
\frac{dD}{dt} &= \delta' I. \\
\delta' &= \delta k. \\
\gamma' &= \gamma k_2.
\end{aligned}
$$

$$
k = \begin{cases} 1, & \text{if } 0.05I <= 35952 \\ 2, & \text{otherwise} \end{cases}
$$

$$
k_2 = \begin{cases} 1, & \text{if } t < 75 \\ 1 + 0.3t, & \text{if } t > 75 \textbf{ and } 1 + 0.3t < 5 \\ 5, & \text{otherwise} \end{cases}
$$



FINAL CONCLUSIONS

- **Complexity can grow infinitely**
  - **Covid was a complex pandemics with lots of variables taking part on it, modelling it as a whole is impossible but some approximations can be really useful**
- **Hospital capacities played a huge role on the pandemic**
- **Vaccination is the best measure**
- **Being aware of new variants is crucial**