Applied Signal Processing and Computer Science
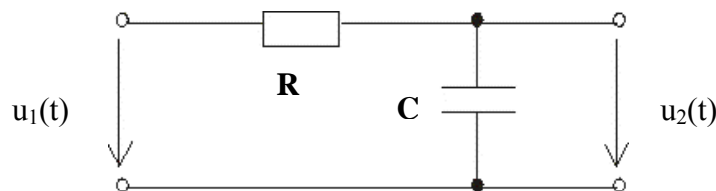## WS 11/12

Tutorial 6: Linear time-invariant systems

1. Impulse response and transfer function:

1.1. An RC element is given (see sketch). At the input a step function $u_1(t) = \gamma(t)$ is inducted to test the transfer function. The following signal is measured at the output:

$$u_2(t) = \gamma(t)\left(1 - \exp\left(-\frac{t}{\tau}\right)\right) \quad \text{with } \tau = R\cdot C$$

- Sketch the input and the output signal.
- Determine the impulse response function h(t) of the system.
- Evaluate the transfer function H(f) of the system and sketch $\left|H(f)\right|$ and $\varphi_H(f)$.
- Now is $u_1(t) = \cos(2\pi f_0 t)$. Evaluate the output signal $u_2(t)$.

1.2. Due to multipath a GPS receiver receives beside the direct signal $u_1(t)$ a weaker version delayed about Δt $u_{multipath}(t) = a \cdot u_1(t - \Delta t)$ with $0 < a < 1$.
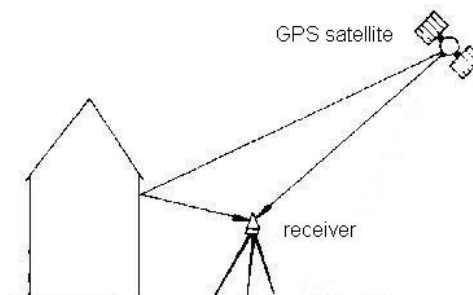
- How does the impulse response function h(t) of the transfer system "transmitter-receiver" of a multipath signal look like? Sketch it.
- Evaluate the transfer function H(f) and sketch $\left|H(f)\right|$.