Application of non-positional representation of information in the form of probabilistic mappings in control systems of unmanned vehicles.

A. V. Skatkov\textsuperscript{1}, A. A. Bryukhovetsky\textsuperscript{1} and D. V. Moiseev\textsuperscript{1}

\textsuperscript{1} SEVASTOPOL STATE UNIVERSITY, 33 Universitetskaya str., Sevastopol, Russia, 299053
The paper considers the use of non-positional representation of information in the form of probabilistic displays in control systems of unmanned vehicles in order to solve the problem of ensuring the reliability and high bandwidth of information exchange channels (IEC) between unmanned vehicles (UMV) located in different environments and dispatch centers (DC). The solution of the management problem of providing a reliable and high-bandwidth IEC between UMV and DC in different environments requires taking into account the dynamically changing stochastic nature of the state of both the object and the subject of management, as well as the external impact on them of both natural and artificial nature in conditions of uncertainty. As shown in the paper, the use of probabilistic representation of information makes it possible to obtain combinations of the main characteristics of UMV control systems that are unattainable in a different form of information representation: speed, accuracy, reliability, and hardware volume.
ME PE (2) and its estimate, which is asymptotically effective, in accordance with (3), are determined by the equations:

\[
M \left[ Y_{x_i}(t) \right] = F_{x_i}(R), \quad \left\{ M \left[ Y_{x_i}(t) \right] \right\}^* = \frac{1}{K} \sum_{j=1}^{K} y_{x_i} = x_i^*.
\] (4)

To fulfill the unbiased criterion, we define ME of estimation \( x_i^* \):

\[
M \left[ x_i^* \right] = M \left( \frac{1}{K} \sum_{j=1}^{K} y_{ij} \right) = \frac{1}{K} \sum_{j=1}^{K} M \left( y_{ij} \right) = F_{x_i}(R) = x_i.
\] (5)

The variance of the estimate is determined to calculate the error of the PTr:

\[
D \left[ x_i^* \right] = \frac{1}{K^2} \sum_{j=1}^{K} \sum_{l=1}^{2} \left[ y_{ijl} - M \left( y_{ijl} \right) \right]^2 P_l = \frac{\left[ F_{x_i}(R) - F_{x_i}^2(R) \right]}{K}.
\] (6)

The expression for standard deviation according to formula (6) will take the form:

\[
\sigma \left[ x_i^* \right] = \sqrt{\frac{F_{x_i}(R) - F_{x_i}^2(R)}{K}}.
\] (7)

Based on formula (7), the number of tests \( K \) required to achieve the allowable error is as follows:

\[
\left[ K \right] = \left( \frac{\sqrt{2} \Phi^{-1}(P)}{\Delta \sqrt{x_i(1-x_i)}} \right)^2.
\] (8)
Effect of pulse interference on the analog-to-probability converter operation

\[ x_1^* = \frac{1}{k} \sum_{j=1}^{k} y_{1,j} \]

\[ x_2^* = \frac{1}{k} \sum_{j=1}^{k} y_{2,j} \]

\[ \Delta = |x_1^* - x_2^*| \]
Conclusion

As a result, the primary converters (PrC) proposed for use in PIS have the ability to integrate random interference and can be structurally executed in the form of integrated circuits (IC). This, in turn, makes it possible to place the PrC in close proximity to the sensors, which is currently very popular when implementing IEC between UMV and DC, located in different environments with high reliability and bandwidth. As the analysis shows, the main advantage of using non-positional probabilistic representation of information is a multiple reduction in the hardware volume of computing devices while maintaining the remaining performance indicators.