SSB-Carrier Mismatch Detection from Speech Characteristics: Extension beyond the Range of Uniqueness

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ABSTRACT

In certain radio-surveillance applications, speech signals with uncertain carrier frequencies may be detected. Beyond other disturbances, carrier mismatches distort the demodulated SSB signals by frequency shifts Df. Recently, a detection and correction of such errors was presented [1], exploiting the harmonic structure of voiced speech with a fundamental (or ”pitch”) frequency fp. Noise-robust, modified pitch-detection methods [2,3] were shown to be applicable, together with an iteratively corrected ”coherent- superposition” algorithm [4,5]. Thereby, carrier errors are corrected reliably [1] - though only within an a-priori uniqueness range $|Df| < fp/2$. In the following, the extension beyond this limitation is presented. It emerges from a closer, statistical analysis of the measurement errors: The measurement statistics within this range are interpreted as a conditional probability density function (pdf) pDf (x|y) conditioned on the actual pitch frequency, its combination with the (measurable) pitch-frequency pdf pfp(y) yields the joint pdf pDf,fp (x,y), and its integration gives the marginal pdf pDf (x). These considerations lead to an even narrower reliability range $|Df| < fp/3$, first. The interpretation of the uniqueness range as one period of an fp-periodic repetition of the measurement statistics, however, leads to the solution: After the same steps as sketched above, the marginal pdf pDf (x) shows a strong peak at the true value Df without a (theoretical) restriction. The resulting algorithm was successfully tested with simulated and real data.