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REGULARIZATIONS OF STATE-DEPENDENT DDES OF NEUTRAL TYPE

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For neutral DDEs the possible discontinuity in the derivative at the initial point may propagate along the integration interval giving rise to a sequence of subsequent points where the derivative is still discontinuous. Being the delay state-dependent, in a right neighbourhood of each such point we have to face a Cauchy problem where the equation has a discontinuous right-hand side. In this case the existence and the uniqueness of the solution is no longer guaranteed to the right of such points and hence the solution of the neutral equation may either cease to exist or bifurcate. After illustrating why uniqueness and existence of the solution is not anymore guaranteed for general state-dependent problems and showing a possible way to detect these occurrences automatically, we explain how to generalize/regularize the problem in order to suitably extend the solution beyond the breaking point. This is important, for example, when exploring numerically the presence of possible periodic orbits.