Previous Next

11.2.1 Introduction and sample problem

MO2.8 **MO2.10**

In this section, we consider the case of a nonlinear scalar (i.e. $M = 1$) IVP. For this case, Equation (11.3) simplifies to,

$$r\left(x^{*}\right)=0 \tag{11.4}$$

As an example, we will consider the following IVP,

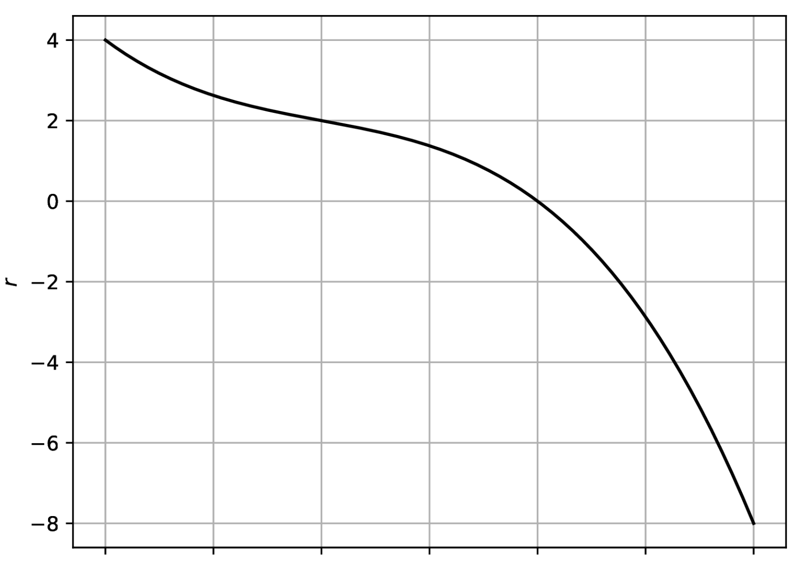
$$\frac{\mathrm{d}u}{\mathrm{d}t}=2-u-u^{3} \tag{11.5}$$

Thus, $f\left(u\right)=2-u-u^{3}$. We picked this $f\left(u\right)$ not based upon any physical system we are making an analogy to, but rather because this $f\left(u\right)$ has a single, simple equilibrium condition (specifically $u_{\mathrm{eq}}=1$) and because $f\left(u\right)$ is a polynomial of u which means it will be easy to differentiate (which we will need to do for one of our algorithms).

In terms of the $r\left(x\right)$ notation, for this IVP,

$$r\left(x\right)=2-x-x^{3} \tag{11.6}$$

This problem can be easily solved, so a root-finding method is not needed. But it will serve as a simple first demonstration of these methods. For now, consider the plot of $r\left(x\right)$ in Figure 11.1. As can be observed, the root is at $x^{*}=1$.



< Previous Next >

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