Algorithm 2 - Newton Euler Direct Dynamics

**procedure** NEDIRECTDYNAMICS
  *Initialize*
  $t = 0$
  $\vec{q} = \vec{q}_0, \dot{\vec{q}} = \dot{\vec{q}}_0, \ddot{\vec{q}} = \ddot{\vec{q}}_0$
  **while** 1 **do**
    Set $\ddot{\vec{q}} = 0$
    Compute $\vec{\hat{\tau}}(t)$ using RNE with $\ddot{\vec{q}} = 0$
    **for** $i = 1$ to $N$ **do**
      Compute the ith column of $D_{ij}$:
      Set $\vec{\tilde{g}} = 0, \dot{\vec{\tilde{q}}} = 0, \ddot{\tilde{q}}_i = 1, \ddot{\tilde{q}}_j = 0[j \neq i]$
      And find $\vec{\tilde{\tau}}$ via RNE
      $D_i = \vec{\tilde{\tau}}$
    **end for**
    Put the columns together to form $D$
    Compute $\ddot{\vec{q}} = D^{-1}(\vec{q})(\vec{\tau} - \vec{\tau}')$
    Integrate to get $\dot{\vec{q}}(t+1)$
    integrate to get $\vec{q}(t+1)$
    $t = t + 1$
  **end while**