```
------------------------------------------------------------------------------
--
--  Purpose:
--
--    utility package of cordic
--
--  Discussion:
--
--
--  Licensing:
--
--    This code is distributed under the GNU LGPL license.
--
--  Modified:
--
--    2012.03.22
--
--  Author:
--
--    Young W. Lim
--
--  Functions:
--  Conv2fixedPt (x : real; n : integer) return std_logic_vector;
--  Conv2real (s : std_logic_vector (31 downto 0) ) return real;
--
--
-------------------------------------------------------------------------------

library STD;
use STD.textio.all;

library IEEE;
use IEEE.std_logic_1164.all;
use IEEE.numeric_std.all;


package cordic_pkg is

  function Conv2fixedPt (x : real; n : integer) return std_logic_vector;
  function Conv2real (s : std_logic_vector (31 downto 0) ) return real;

  procedure DispReg (x, y, z : in std_logic_vector (31 downto 0);
                     flag : in integer );
  procedure DispAng (angle : in std_logic_vector (31 downto 0)) ;

  constant clk_period : time := 20 ns;
  constant half_period : time := clk_period / 2.0;

  constant pi : real := 3.141592653589793;
  constant K : real := 1.646760258121;

end cordic_pkg;



package body cordic_pkg is

  -----------------------------------------------------------------------------
  function Conv2fixedPt (x : real; n : integer) return std_logic_vector is
  -----------------------------------------------------------------------------
    constant shft : std_logic_vector (n-1 downto 0) := X"2000_0000";
    variable s : std_logic_vector (n-1 downto 0) ;
    variable z : real := 0.0;
  -----------------------------------------------------------------------------
  begin
      -- shft = 2^29 = 536870912
      -- bit 31 : msb - sign bit
      -- bit 30,29 : integer part
      -- bit 28 ~ 0 : fractional part
      -- for the value of 0.5
      -- first 4 msb bits [0, 0, 0, 1] --> X"1000_0000"
      --
      -- To obtain binary number representation of x,
      -- where the implicit decimal point between bit 29 and bit 28,
      -- multiply "integer converted shft"
      --
      z := x * real(to_integer(unsigned(shft)));

      s := std_logic_vector(to_signed(integer(z), n));

      return s;

  end Conv2fixedPt;
  -----------------------------------------------------------------------------



  -----------------------------------------------------------------------------
  function Conv2real (s : std_logic_vector (31 downto 0) ) return real is
  -----------------------------------------------------------------------------
    constant shft : std_logic_vector (31 downto 0) := X"2000_0000";
    variable z : real := 0.0;
  -----------------------------------------------------------------------------
  begin
    z := real(to_integer(signed(s))) / real(to_integer(unsigned(shft)));
    return z;
  end Conv2real;
  -----------------------------------------------------------------------------


  -----------------------------------------------------------------------------
  procedure DispReg (x, y, z : in std_logic_vector (31 downto 0);
                     flag : in integer ) is
  -----------------------------------------------------------------------------
    variable l : line;
  begin
    if (flag = 0) then
      write(l, String'("--------------------------------------- "));
      writeline(output, l);
      write(l, String'("  xi = ")); write(l, real'(Conv2real(x)));
      write(l, String'("  yi = ")); write(l, real'(Conv2real(y)));
      write(l, String'("  zi = ")); write(l, real'(Conv2real(z)));
    elsif (flag = 1) then
      write(l, String'("  xo = ")); write(l, real'(Conv2real(x)));
      write(l, String'("  yo = ")); write(l, real'(Conv2real(y)));
      write(l, String'("  zo = ")); write(l, real'(Conv2real(z)));
    else
      write(l, String'("  xn = ")); write(l, real'(Conv2real(x)));
      write(l, String'("  yn = ")); write(l, real'(Conv2real(y)));
      write(l, String'("  zn = ")); write(l, real'(Conv2real(z)));
    end if;
    writeline(output, l);
  end DispReg;
  -----------------------------------------------------------------------------


  -----------------------------------------------------------------------------
  procedure DispAng (angle : in std_logic_vector (31 downto 0)) is
  -----------------------------------------------------------------------------
    variable l : line;
  begin
    write(l, String'("  angle = ")); write(l, real'(Conv2real(angle)));
    writeline(output, l);
    write(l, String'("....................................... "));
    writeline(output, l);
  end DispAng;


end cordic_pkg;
```