162.5MHz LLRF System Development for HIMM Linac

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Introduction
The Heavy Ion Medical Machine (HIMM) is the cancer treatment equipment designed by the Institute of modern physics (IMP), and which adopts a 7 Mev cyclotron as injector. IMP plans to replace it with a Linac to increase the beam intensity. So the HIMM Linac is designed which consists of an ECR ion source, a RFQ, a IH – DTL and two bunchers. RF system works in pulse mode.

Parameters of LLRF system

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>162.5MHz</td>
</tr>
<tr>
<td>Repetition rate</td>
<td>1 Hz</td>
</tr>
<tr>
<td>Duty</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Amplitude stability</td>
<td>1%</td>
</tr>
<tr>
<td>Phase stability</td>
<td>±1</td>
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</tbody>
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System design and implementation

Hardware:
- Commercial card
- 4 ADC, 16 bits, 250 Msps (Max.)
- 2 DAC, 16 bits, 500 Msps (Max.)
- Xilinx V5 FPGA, TI TMS320C6713 DSP
- Gigabit Network Interface

I/Q control in FPGA
- I/Q sampling is adopted.
- PI controller
- FF control

Summary
The LLRF prototype has completed the hardware platform, next step is to test I/Q control function, and more function will be tested in the future.
- Detune measurement algorithm
- Adaptive feed-forward algorithm
- GUI program test