

Modular Multilevel Converter/Alternate Arm Converter for High Frequency Networks

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Abstract:

In the present scenario, use of multilevel inverters, modular multilevel converters (MMC) an alternate arm converters (AAC) in high power and high frequency applications clearly can be seen. The MMC-HVDC has the advantage in terms of scalability, performance, and efficiency over two-and three-level VSC-HVDC. A very high quality and low distortion of output voltage, low blocking voltage of semiconductor switches and the reduction of the size of the links and capacitors in modular converters (MMC) are more advantageous than conventional voltage source converters. Additionally to concentrate the volume of the capacitors of the cells increasing the frequency is beneficiary, also using high frequency can be bring benefits to other passive components such as the transformer etc. Here a Novel Fuzzy based comparison is presented for 350 Hz, 30MW interconnected network using MMC and AAC for better voltage profile and smooth operation and validated in Matlab simulink.

BASIC CONCEPT OF DC/AC/DC SYSTEM

Front-to-front concept for the AC to DC converter is as shown in the below. For this type on the illustration mutual classification of converters are given away. By this illustrated technologies also we can design by using modular multilevel converters or by alternate arm converters, which they are connected to one common dc link.

Here a 3ϕ illustration is given away in the figure and it is inspecting inside this document other than the digit of cases and levels are our option. The digit of phases concentrates the volume for the converter and extra phase legs & the filters from DC part and lastly victims. By considering 3ϕ structure and the currents cause in every phase is combined with the current from dc side to form a sixth order harmonic wave.

Fig. illustrates both cases of voltage source inverters. The main difference between these two is in the valves. The modular multilevel inverter consists only of cells moreover half-bridge /full-bridge cells. And in this alternate arm converters are consists direct switches by the replacement of cells. In the modular multilevel converter is half of the alternate current wave. The alternate arm converter is entirely different operation when compare with the modular multilevel converter by conduction the full cycle of alternate current wave by the top and bottom arm alternately for each half cycle. While the additional arm not is conduction for every current wave from and that direct switch unlock when flouting the current wave form lane and blocks of a voltage of each cell or cell stack. Such stack during the conduction arm is fully conscientious for generation of alternating waveforms.

Case Study

This type of reproduction facsimile was residential into SIMU-LINK that proves the operable for the structure. Though in that device method is appropriate in the HVDC

implementations in generally for many KV and many megawatts in the imitation form was climb for considerably lesser voltage plus power levels. certainly the system been right behind in the semiconductor unit stage with practical voltage specifications could be need an oversized variety on the switches near exist that might create the reproduction also computational complicated near be sensible. Such system was modeled within those points toward exactly approximation these losses mistreatment representation precise post dispensation text as well as to confirm a cell level process. The specifications general toward every simulation for the case-study organism square measure planned within 4.1.4.1. 2 totally dissimilar scheme topologies are changed like single by 2 MMCs plus lone by 2 AACs. Device parameters square measure planned into given tables 4.1.4.2 and 4.1.4.3. The unit capacitance used for the fifty rate replication was located near 7mF in each converter. Because of the variety of cell spinning for each cycle be unbroken stable for each AC frequencies and cell capacitance can live compact to one medium frequency used for 350 rate simulations. As of the device parameters the separate distinction between AAC and MMC are often illustrious and the MMC unit loads ought toward be capable to sustain the complete AC wave form plus so need considerably a lot of cells compared to the AAC. That not needed toward come up with Associate in nursing ac voltage on top of t the DC lethal however solely needs half- ridge cells. That nDiCP is not up to the AAC's as a result of its arms square measure incessantly operate an AC & DC current. But the within an AAC every section is simply operate the AC voltage used for single semi phase.

Table.4.4 MMC transformer parameters

| Parameters | At 50 Hz | At 350 Hz |
|-----------------------|----------|-----------|
| Coupling factor MMC | 0.995 | 0.995 |
| Magnetizing – (L) | 5.9 H | 0.8 H |
| Primary leakage (L) | 29.8 mH | 4.3 mH |
| Secondary Leakage (L) | 10.8 mH | 1.6 mH |

In the overlap amount of the AAC was unbroken stable at 18° for all simulations. These interpret into a fundamental quantity of 1ms for each half cycle by associate AC frequency is fifty cycle with keen on zero. For 350 cycle generated ac at 14 ms apiece half cycle. The arm inductance within an AAC is mainly needed toward regulate the overlies currents. Therefore, ascend it behind through frequency sustain small or no additional shift fatalities with makes the ramp for an overlies currents simple. Reducing the arm inductance through AC frequency within MMC during the parallel during perceptibly superior shift fatalities because a DC current elegant from side to side the arms must exist proscribed intended for the complete period in the phase. Arm inductance principles on fifty cycles were willy-nilly selected to keep up current management within the inverters while not further shift in the stages. MMC valves area unit unendingly in physical phenomenon plus may thus be thought of as 3 series-connected combines of voltage sources within equivalent through a sequence associated couple for an voltage inputs modeling to the DC terminals.

Little variations into energy for every of the regulator voltages will result in giant dc currents curving among. Arm inductances provide to add up straight this with border the speed of amendment an arm current. Thanks for disconnected physical phenomenon within the arms lesser of the arm inductances may exist employed in the AAC like each stages within the identical part area unit solely in physical phenomenon at the same time for a brief overlap amount throughout every cycle. In the Alternate arm converter the arm inductance price could be a swap among the degree with physical phenomenon sufferers thanks to it by therefore the further shift losses are not occur throughout the overlies amount toward keep up modern management. The arm inductance designed for an MMC be unbroken by 1mH of the frequencies.

AAC associate an arm inductance at 0.7mH is worn by fifty cycles also zero and 1mH at 350 cycles. The single-phase electrical device was shapely employing a coefficient of mutual induction form. Rejection resistive parts are enclosed within a instant field simulation form of the electrical device. Electrical device specifications on fifty as well as 350 cycle area unit planned in Tables. The electrical device models contrast a little because the magnetizing-inductance has changed primarily based ahead to set part for the derivative current enormity of a hundred and twenty fifth.

Outputs

The system steady state process is incontestable and drawing a range for the voltages moreover currents in the system method using multilevel modular inverters operated at 350cycles/second. Demonstrates the overall identical currents in addition to voltages of the system victimization alternate arm converters at 350 cycles/second additionally. Each system run

a thirty MW power result the HV1 aspect to the HV2 aspect. The unit loads within AAC will exist to seen to get a way lesser max out voltage than individuals within an MMC when they are doing not include near be compelled to sustain an AC voltage undulation on the complete cycle. Within the principal and inferior voltage outputs given away for an AAC voltage spikes will exist distinguished.

Such square measure as a result of explosive shift of stages to slope the lie on top current near the required worth as rapidly when attainable because a result of the succinctness of the extend beyond amount. The ac current is divide equally among each arms while the AAC artillery include to be compelled to carry out the complete AC current in the half cycle every. Ac voltages obtained through an AAC square measure beyond individuals for the multilevel modular converter. That leads to minor AC current enormity. Because an AAC be operated on the sweet spot energy and the power moves as of dc as well as ac aspect square measure minded.

Therefore, solely moderate leveling currents have to be compelled to be going to during the arms throughout the overlap amount.

The MMC needs a big DC current toward exist dart during this arms in conjunction by the AC current. Hence the height current during this arm isn't considerably totally dissimilar within moreover device method. It was often necessary toward notice because the victims a lot rely lying on the present volumes plus also a variety procedure on the conductivity alleyway. The DC association currents are exposed intended for each system square measure DC outcome in the device stages. This type of currents could motionless need DC aspect riddle during a genuine system that would not be thought of during in presented document. Dc-link currents as of the AAC will exist see near possess a few lofty frequency harmonic contented as a result of the lie on top current skewer. Such sect

voltages will live see toward exist unbiased used for each system methods within the underneath wave forms. The typical on an intra cycle power flood form be specified during the typical sect voltage on each converter by the side of their several operative stages. What is more, a 2 methods display identical energy movement away varies in spite of the various varieties for the cells within such loads. Because of a cell capacitors square determine for the identical dimension during in the each belongings that means to further area investments will exist reached through victimization of AAC more than an MMC.

SIMULATION RESULTS

MATLAB CIRCUIT DIAGRAM

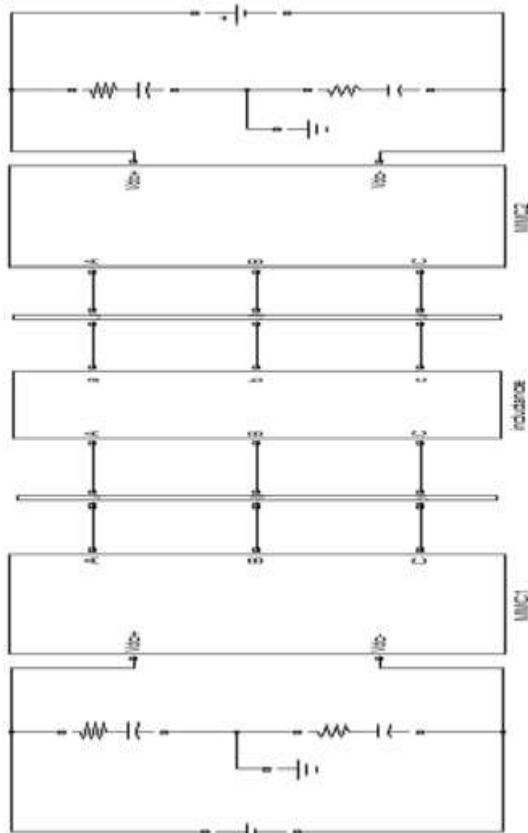
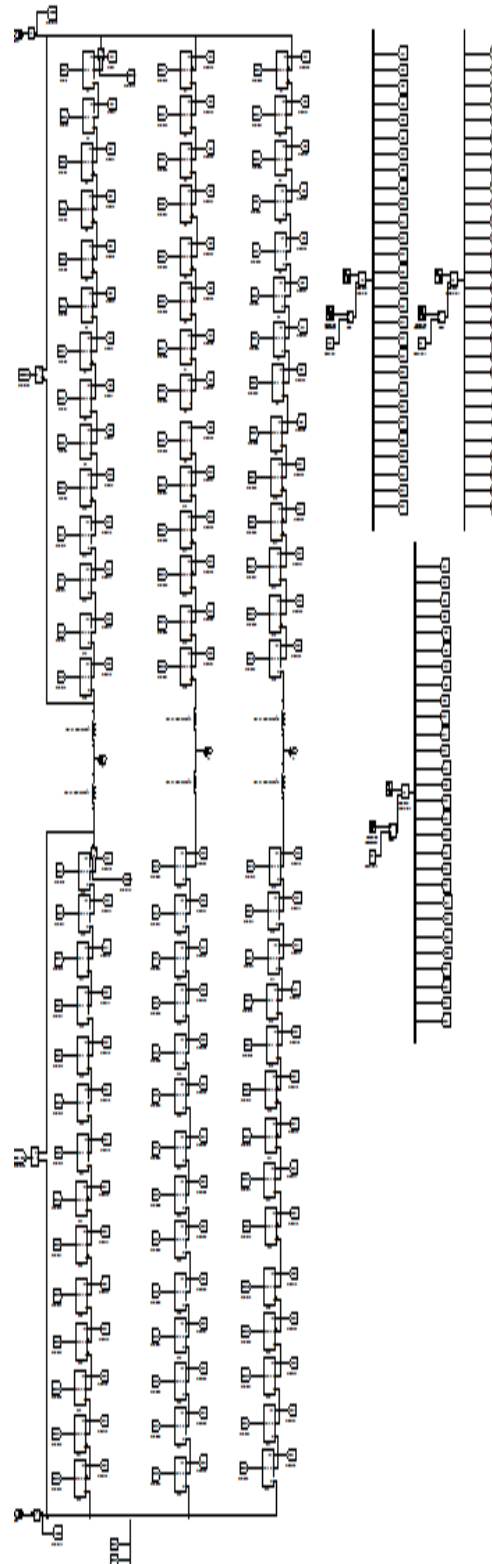


Fig.6.1 Matlab Circuit for MMC/AAC of HVDC System

SUBSYSTEM1



Subsystem of a MMC

CONTROL CIRCUIT

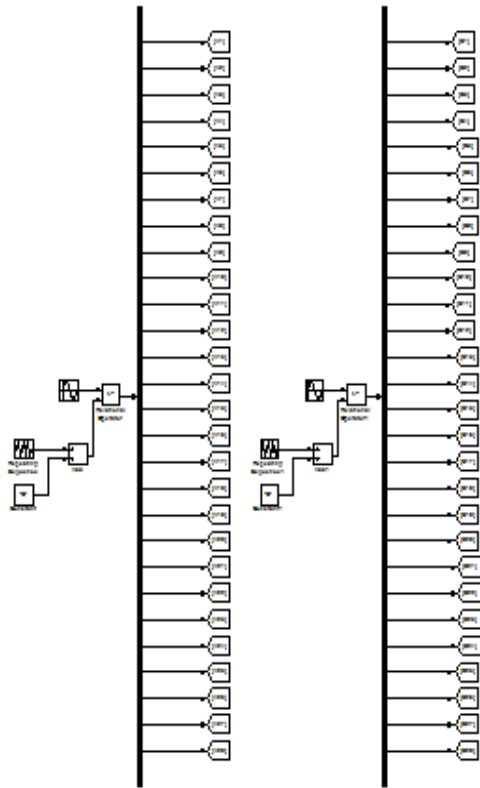
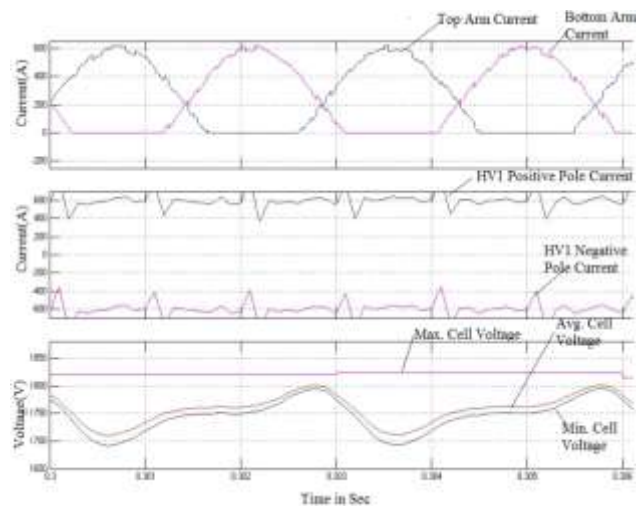
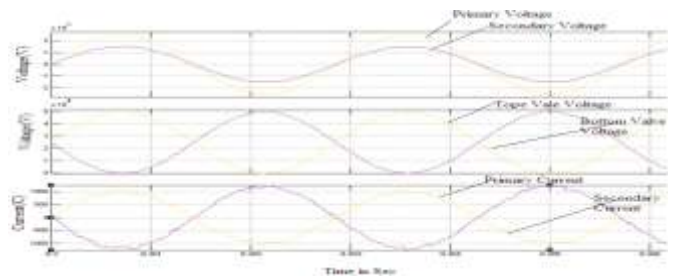


Fig. Control Circuit



Voltages and Currents for MMC

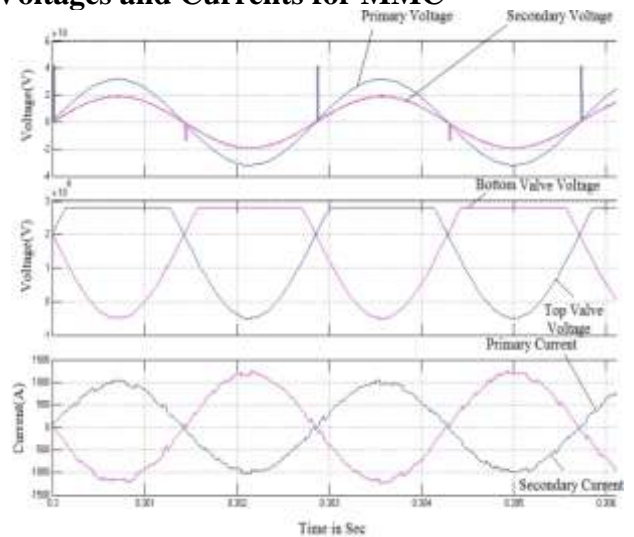
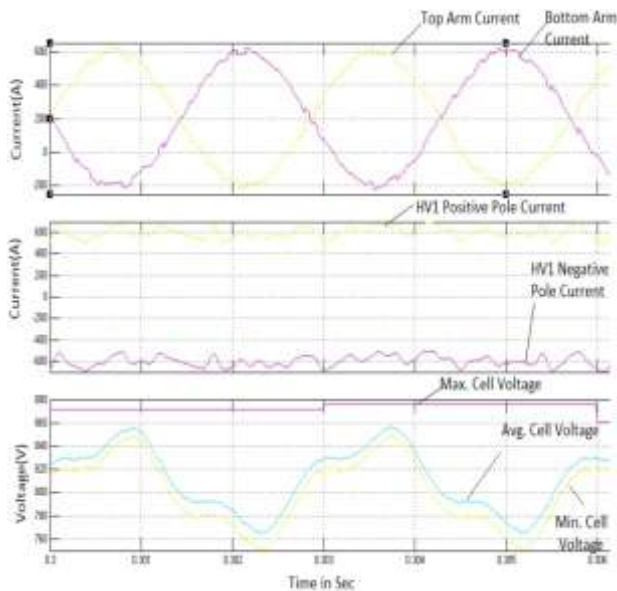


Fig. Voltages and currents for MMC

Voltages and Currents of AAC at 350Hz AC Link and A Single Phase Led Valve Voltages, Arm Currents of AAC-HV1 & Cell Voltages are also shown in the same Phase in HV1

CONCLUSION

The design and presentation for the Modular multilevel Converter and Alternate arm converter with a fuzzy logic controller has been presented in this paper. It is observed that the Alternate arm converter be found a required lowest amount total capacitance for all ac frequencies than Modular multilevel converter. The employ of the Alternate arm converter moreover 50 or 350 Hz frequency could be consequently minimize the volume of system. Modular multilevel converter was institute that it has somewhat lesser power losses when compare to the Alternate arm converter on 50 Hz procedure. It has occurred owing to superior conduction losses into the Alternate arm converter. The switching losses would be increase more quickly in Modular multi level converter than Alternate Arm Converter at increase ac frequency so that it requires more switching measures. Operating frequency is increases then altered the stability of core & winding losses into the transformer except did not widely raise the on the whole power loss for this module. The proposed work is aimed on the investigation of possible modeling and Fuzzy based control scheme for the modular multilevel converter of HVDC system with the purpose for identifying the impact of such modeling and control on the dynamics of the conversion system.

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